CHALLENGES OF THE SIGNAL OFFICER IN THE DECADE OF COMMAND AND CONTROL

A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

MASTER OF MILITARY ART AND SCIENCE

by

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Research conducted on the impacts of C3 force integration is reported. An introduction is provided into the numerous challenges facing the Army division level Signal officer in the 1990s. The challenges emerge from the consecutive modernization of organizational, doctrinal, and materiel force integration programs amid declining personnel resources and a high technology battlefield environment. Analysis is focused on the impacts to the divisional MSE Signal battalion S3 staff of fielding three new C3 systems: The Maneuver Control System (MCS), the Joint Tactical Information Distribution System (JTIDS), and the Integrated System Control (ISYSCON). Impacts are categorized in terms of C3 functional areas: personnel, equipment, procedures, training, and leadership. Suggested improvements to training, network management procedures, and materiel acquisition practices are provided for materiel developers, combat developers, and tactical Signal Corps leadership. Recommended areas for further studies are included.

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent those of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

CHALLENGES OF THE SIGNAL OFFICER IN THE DECADE OF COMMAND AND CONTROL by CPT (P) David S. Velasquez, USA, 148 pages.

Research conducted on the impacts of C3 force integration is reported. An introduction is provided into the numerous challenges facing the Army division level Signal officer in the 1990s. The challenges emerge from the consecutive modernization of organizational, doctrinal, and materiel force integration programs amid declining personnel resources and a high technology battlefield environment.

Analysis is focused on the impacts to the divisional MSE Signal battalion S3 (operations) staff of fielding three new C3 systems. The new systems analyzed are the Maneuver Control System (MCS), the Joint Tactical Information Distribution System (JTIDS), and the Integrated System Control (ISYSCON). Impacts are categorized in terms of C3 functional areas: personnel, equipment, procedures, training, and leadership. Suggested improvements to training, network management procedures, and materiel acquisitions practices are provided for materiel developers, combat developers, and tactical Signal Corps leadership.

Recommended areas for further studies include the impacts of C3 force integration to other division level staff and leadership, and the impacts of other C3 force integration programs as force integration programs and the Army force structure continuously changes to provide challenges in the decade of command and control.

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The thesis advisors were the best. Bill Clingempeel-- a friend, and mentor, provided valuable insight. Tony Cerri and Jim Forlenzo provided instrumental focus and feedback. Robert Mangrum had me follow a steady course.

My wife, Teresa, provided incredible support and incentives. I know that my daughter, Veronica, knows that I do all these things with her always in my heart.

The intent of this research was to prepare for a tactical Signal assignment. This never materialized. I hope that this thesis will prove useful to those who will actually face the technical and tactical challenges in the decade of command and control.

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CHAPTER 1

INTRODUCTIONN

BACKGROUND. Effective command, control and communications (C3) is a significant combat force multiplier. The high priority which the Army has placed in C3 will critically impact how military operations are conducted. The Signal officer will face many challenges in developing, fielding, and integrating many of the new C3 systems into the force during the 1990s. The diversity and scope of such challenges makes C3 force modernization a timely topic which demands more than superficial analysis.

During the 1980s, with the explosion in information technology, the role of the Signal officer within the division has similarly grown in scope and magnitude. This growth has taken the Signal officer's responsibilities from a combat communicator focused on the operations of combat communications systems to a subject matter expert on communications and automation in garrison and in the field. Most recently, the Signal officer is heralded as an information systems manager responsible for communications/automation wide area network integration and management.

What are the challenges? This thesis will identify several specific challenges the Signal officer will face based on this rapidly changing role. Setting the stage with the basic principles and definitions, an introduction is provided of significant force modernization programs that both directly and indirectly affect the Signal officer. Following a brief review of currently available references, in chapter two, the third chapter provides a methodology for explaining how analysis will determine the challenges awaiting the Signal officer. This analysis is in chapter four. Conclusions and recommendations, in chapter five, based on the analysis complete the thesis.

This chapter provides an introductory description of selected force modernization programs to broadly overview of the challenges of the Signal officer.

An explanation of the relationship between command and control (C2) and the divisional Signal officer's responsibilities is required to understand why the challenges are significant. Any explanation must logically begin with a description of C2. The definition of command and control begins with "the exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of a mission." A variety of functions are required to execute C2. "C2 functions are performed through an arrangement of personnel, equipment, communications, facilities and procedures employed by a

commander in planning, directing, coordinating, and controlling forces and operations."(1)

The Signal officer has significant responsibilities inherent in the execution of Army C2. This is because C2 is often used interchangeably with C3. Command, Control and Communications (C3) is a term that is basically undefined in most formal military texts. Although the term C3 is generally accepted within defense industry and the government, the definition is twisted by semantics, misinterpretations, and perceptions. For the purposes of this thesis, C3 will be defined as communication networks to support C2, or the combination of C2 automation support systems and communications networks.

Table 1: C3 FUNCTIONAL AREAS

C3 FUNCTIONAL AREAS
PERSONNEL
EQUIPMENT
PROCEDURES
TRAINING

Based on these definitions, Table 1 shows the functional areas of C3. Training has been added to the list because only trained personnel can properly use new equipment or procedures.

C2 is a dynamic, fast-paced topic. The rate at which the Army's emphasis on C2 has changed is a reflection of the evolution of warfare, changes caused by technological advances, and the availability of new devices and techniques to aid decision making. The execution of C2 is considered

key to success on the future battlefield. "During the coming decade, the Army must stress the importance of command and control. The decade of the 90's will be the decade of command and control."(2)

The devices and techniques currently planned to assist the commander in executing C2 include battlefield automated systems (BAS), communications networks, and network management systems. These systems are scheduled for fielding in the years 1992 to 1999 through force integration.

Table 2: AREAS OF FORCE INTEGRATION

AREAS OF FORCE INTEGRATION
DOCTRINE
ORGANIZATION
EQUIPMENT/MATERIEL
ARCHITECTURE

Force integration is the process used to manage orderly change in the Army. "It [force modernization] is the introduction, incorporation and sustainment of new doctrine, organizations and equipment into the existing force structure."(3) Based on this definition, Table 2 shows the areas of force integration. Architecture has been added as an area to denote the significance of technology insertion into current equipment.

The force integration process rapidly incorporates numerous new capabilities and characteristics into the force. Each force integration area has numerous programs to

provide the specific 'devices and techniques' to commanders and units in the field army. Table 3 lists a small sampling of the programs currently planned for introduction into the force structure, broken down by force integration area. Some of those programs listed are specifically related to C3, e.g., the Army Tactical Command and Control Systems (ATCCS) automation systems and its supporting communications networks. Others such as Airland operations are general operational concepts that apply not only to C3, but span the spectrum of the Army's battlefield operating systems.

Table 3: SAMPLE C3 RELATED FORCE INTEGRATION PROGRAMS

FORCE INTEGRATION C3 PROGRAMS
DOCTRINE:
DESERT STORM LESSONS LEARNED
AIRLAND OPERATIONS
MATERIEL:
ATCCS AUTOMATION SYSTEMS
COMMUNICATIONS NETWORKS
ORGANIZATION:
INFORMATION MISSION AREA
JOINT SPECIALTY OFFICERS
ARMY ACQUISITION CORPS
ARCHITECTURE:
BATTLEFIELD INFO ARCHITECTURE

It is imperative to note that while each of the C3 programs listed in Table 3 have implications, few are designed to make the Signal officer's job easier. Rather, most are designed to help the maneuver commander execute C2. Nonetheless, the successful use of each program when fielded or implemented in the division will require a

significant increase in efforts by the responsible Signal officer.

The Signal officer has historically had significant challenges to confront in the execution of C3. The impact of these recent C3 force integration programs have expanded the influence of the Signal officer and the challenges to confront on the future battlefield. A short explanation of some of these force integration programs is required for proper appreciation of the significant challenges presented to the Signal officer.

Airland Operations is a prime example of a doctrinal force integration program which has significant C3 implications. Airland operations is the Army's "operational level umbrella concept describing how Army forces will operate in the future"(4) as a land component in Joint/Combined operations. This doctrinal improvement designed to implement a changing National Military Strategy considers a fluid and nonlinear extended battlefield. Such employments will strain traditional C3 assets employed by the Signal officer and his soldiers, thus requiring innovative equipment and techniques to support the commander.

The ATCCS is an automation based distributed network of systems designed to facilitate information flow on the battlefield while enhancing the force commander's tactical decision making process. The ATCCS is the Army's key

materiel force integration program. Figure 1 shows a commonly accepted depiction of the ATCCS architecture.

The ATCCS is comprised of five battlefield functional areas (BFA): maneuver, air defense, fire support, intelligence/electronic warfare, and combat service support (CSS). Each BFA supports C2 with the aid of an automated C2 systems: the Maneuver Control System (MCS), the Forward Area Air Defense System (FAADS) Command and Control (C2), the Advanced Field Artillery Tactical Data System (AFATDS), the All Source Analysis System (ASAS), and the CSS Control System (CSSCS).

The automated C2 systems of the ATCCS are networked across the battlefield by communications systems (read C3 systems) represented by the circles in the center of Figure 1. These C3 systems are the Area Common User System (ACUS), the Army Data Distribution System (ADDS), and the Combat Net Radio (CNR) system.

The ACUS systems are the Mobile Subscriber Equipment (MSE) and the Tri-service Tactical Communications System (TRI-TAC) [telephone] systems. The ADDS is composed of the Enhanced Position/Location Reporting System (EPLRS) and the Joint Tactical Information Distribution System (JTIDS) [computer communications] systems. The CNR includes the Single Channel Ground/Airborne Radio System (SINCGARS), the Improved High Frequency Radio (IHFR), and Radio-Teletype

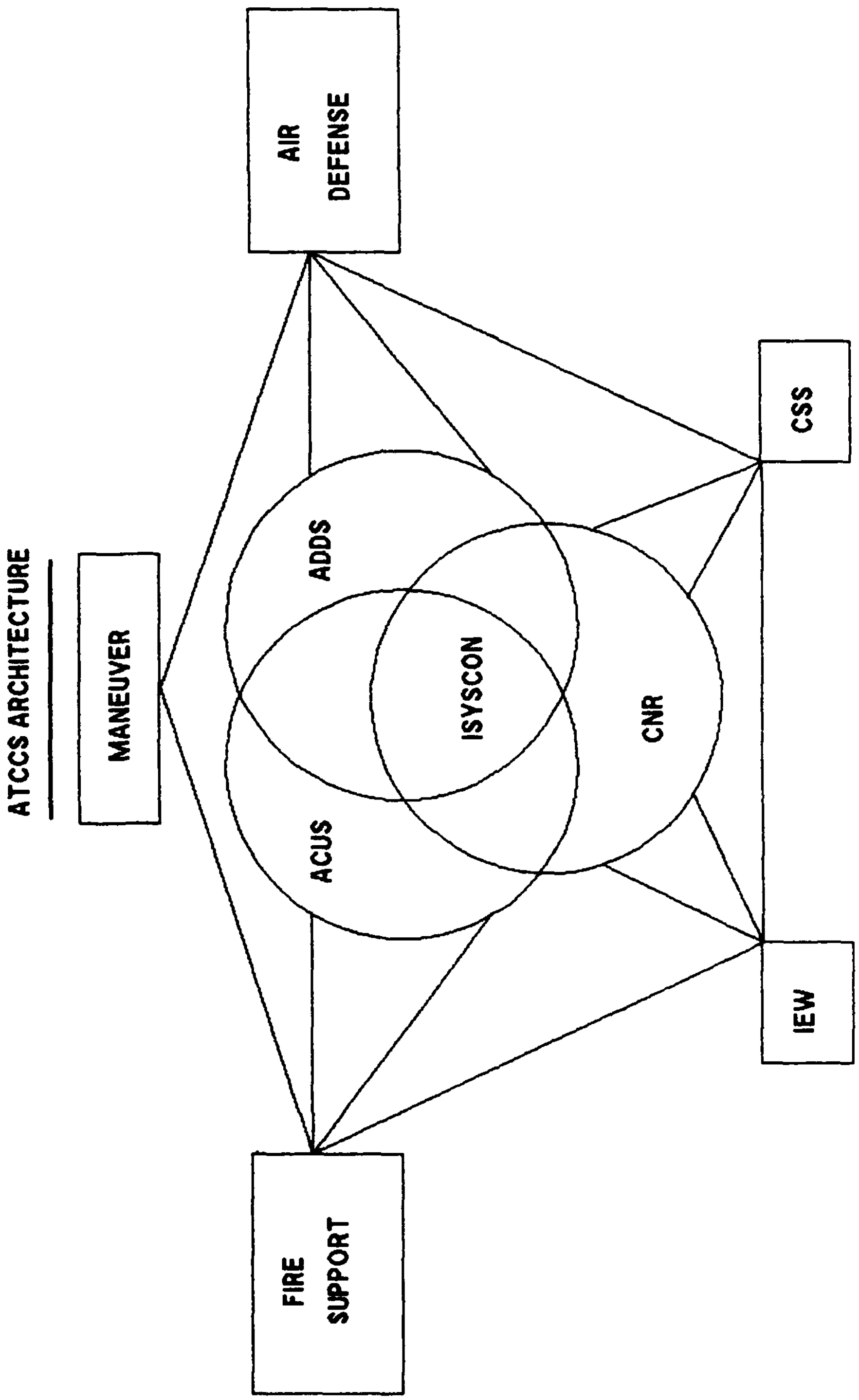

Figure 1: THE ATCCS ARCHITECTURE

SOURCE: U.S. Army CGSC, C4000-11, Contingency Force Operations, C3 and Synchronization (U.S.Army CGSC,1990), L11-I-3.

(RATT) [frequency modulated (FM) and amplitude modulated (AM) radio systems].

The various communications networks, when employed simultaneously, are referred to as the wide area network (WAN). The Integrated System Control (ISYSCON), shown at the intersection of the three 'C3' circles of Figure 1, is the automation based WAN management system. Currently, the ISYSCON is the only planned source for a complete status of ATCCS electronic connectivity.(5)

The fielding of the ATCCS will place a large quantity of new automated C2 and communication systems in the force structure. The functions of the Signal officer will increase significantly, especially at organizational levels from the corps to the maneuver battalion level. The Signal officer will retain current supervisory staff responsibility for automation and communications, and will become a user of the ATCCS (specifically, the Maneuver Control System (MCS) and the ISYSCON, which will be used both within the S-3 cell of the divisional Signal battalion and at the division Signal office). Additionally, the Signal battalion S3 cell performs network control and management of all divisional communications systems.

The staff supervisory responsibility of the Signal officer for automation and communications was the result of an organizational force integration program. That program, the Information Mission Area (IMA), assigned significant C3

Table 4: THE FIVE DISCIPLINES OF THE IMA

DISCIPLINES OF THE IMA
COMMUNICATIONS AUTOMATION VISUAL INFORMATION RECORDS MANAGEMENT PUBLICATION

responsibilities. The reorganization brought about by the IMA was the Army's response to the massive strides made in information technologies.

The Information Mission Area (IMA) includes all resources and activities employed in the access, use, retention and management of information. By definition then, Signal support to the commander became the implementation of the IMA. The IMA changed the meaning of Signal support from mere combat communications to include all facets of information technology.

The implementation of the Information Mission Area (IMA) into the tactical level provides for the realignment of manpower and organization to prepare the Army for the advances in battlefield information technology. It will alter the division commander's traditional primary staff responsibilities and Signal staff responsibilities because the IMA expands Signal support to far more than simply combat communications. The IMA involves more than the Signal Corps because every battlefield operating system uses the five disciplines of the IMA: communications, automation,

visual information, records management, and publication. The five disciplines of the IMA are listed on Table 4.

Every information user on the battlefield (as well as in garrison) has a significant role in the use of the IMA. But significantly, the Signal officer is responsible for all information service support functions.(6) Based on this significant increase in Signal support responsibility, the division and corps Signal officer is now dual hatted as the staff G-6, Assistant Chief of Staff for Signal Support.

The Battlefield Information Architecture (BIA) is and example of an architectural force modernization program. The BIA is the evolving architectural strategy for the Army's C3. It is based on an objective C3 system that is technologically achievable and provides equivalent services in both garrison and field environments by maximizing commercial 'off-the-shelf' standardized technology to minimize costs and development time.

The BIA is a complex strategy designed to couple the automated C2 devices on the battlefield with their supporting C3 networks to provide an efficient and user-transparent C3 system, regardless of user location. To explain the BIA fully is beyond the technical scope of this introductory chapter. A single page summary representation of the strategy, highlighting key technical features addressed as a function of time, is provided at Figure 2.

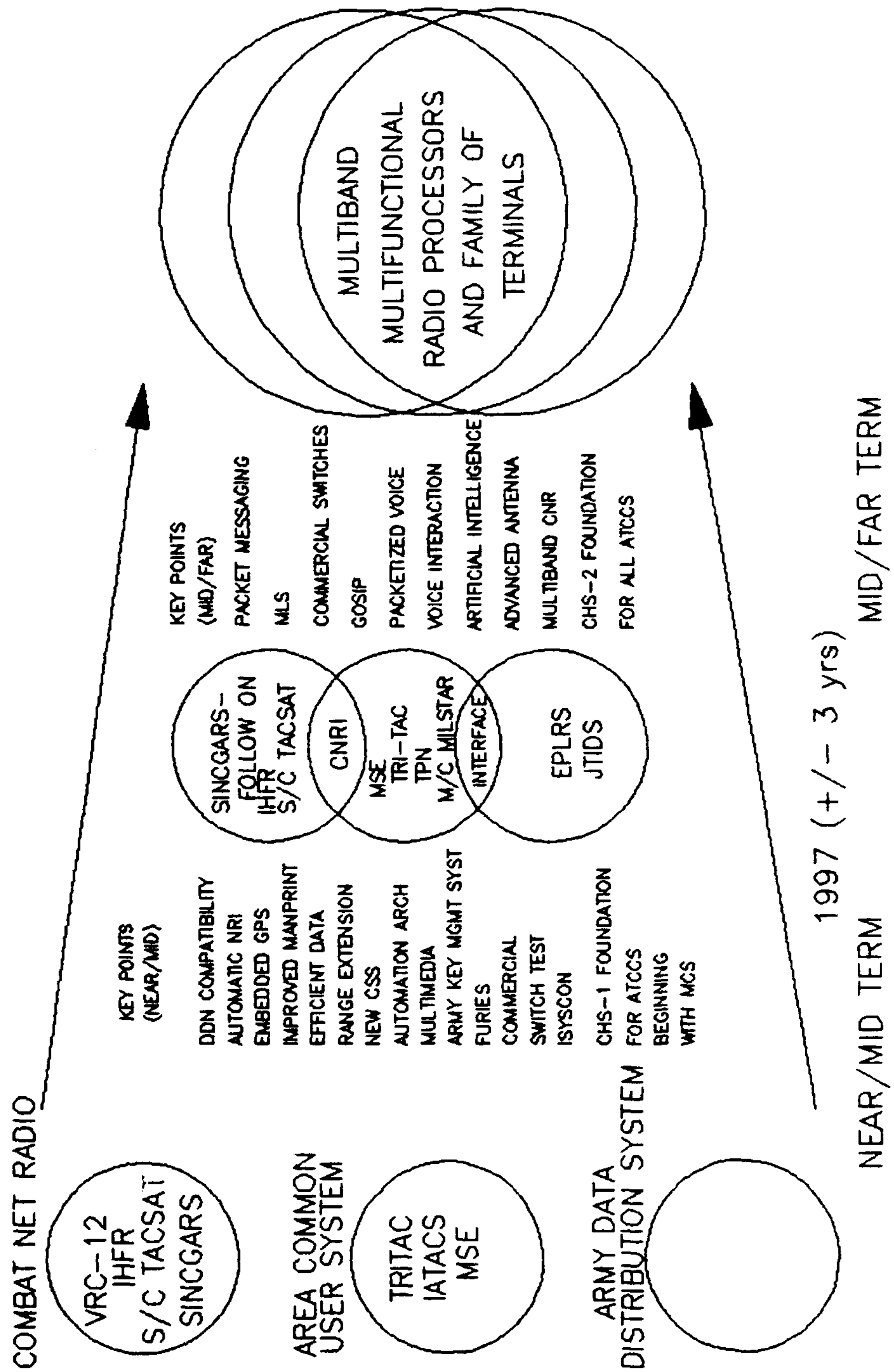

Figure 2: THE BATTLEFIELD INFORMATION ARCHITECTURE

SOURCE: U.S. Army Signal Center, "Program Summary Sheets," (FT. Gordon, GA: U.S. Army Signal Center Directorate of Combat Developments, 1991), 204.

Planned for incremental implementation in the year 1997 (+/- three years), the BIA provides a strategy that focuses on correcting current C3 system's deficiencies in the near term, such as data handling efficiencies of the C3 systems and the processing power of the supported C2 systems. Improving the internetworking capabilities of the current 'stovepiped' C3 systems and devices is an example of a mid term goal. In the far term, the strategy calls for achieving a truly integrated and user transparent network through the use of advanced technology, including multiband radios and advanced antennas.

The BIA provides the 'roadmap' to support the evolution of communications and automation materiel to satisfy the multimedia based information management needs on the future battlefield. Signal support responsibilities will surge both tactically and technically as the BIA emerges. The challenges to the individual Signal officer will be dynamic.

The division Signal officer will require a highly trained and effective staff and organization to meet the demands of an emerging doctrine employing new systems to win on a more challenging battlefield. Staff effectiveness will be required to keep pace with the dynamics of a fluid battlefield where planning, execution, and reconstitution will occur simultaneously. A highly trained staff will be required to understand the technical details of the systems

that support C2 on the battlefield. In order to meet the challenges that face the Signal officer, the best and brightest officers are needed in tactical assignments to execute the mission. A summary of key members of this staff is necessary to understanding the personnel resources available to the divisional Signal officer to meet the challenges of the next decade.

The division Signal officer (DSO) is dual-hatted as the divisional Signal battalion commander. He holds the rank of a Lieutenant-Colonel. He is a member of the division staff, and is responsible to the division commander for Signal support (tactical application of the IMA). He works, through the division Chief of Staff, on overall automation and communications issues that affect the command. The DSO advises the division commander, staff and all divisional units on tactical information management.(7)

The DSO has three key officers, authorized at the rank of Major, to help him provide the divisional C3 system: the Assistant G-6, (formerly Assistant Division Signal Officer (ADSO)), the Signal battalion Executive Officer (XO), and the Signal battalion S3. The Signal officer in the division is assisted in executing the mission by these three staff officers.(8)

The ADSO serves as the DSO's representative in most routine division staff actions, and serves as the Assistant G6. He supervises the division Signal office (the G6

staff). The ADSO and the division Signal office are assigned as part of the Signal battalion, but work on, and are located with, the division staff. The ADSO, in coordination with the Signal battalion S3, performs mission analysis and initial tactical Signal support planning, including the support requirements of all the units in the division's area. In keeping with the concept of the Information Mission Area, the division automation staff officer is also assigned to the division Signal office.(9)

The Signal battalion XO is the principle assistant and advisor to the DSO. He serves as second in command of the division Signal battalion and represents the commander in his absence. The XO is responsible for staying informed of the battalion's logistical and tactical situation. He supervises the battalion's administrative and logistical operations and the battalion staff to free the commander for operational supervision.(10)

The battalion S3 is the operations officer. He supervises the operations staff. He has staff responsibilities in organization, operations training, and plans of the Signal battalion. The S3 operations staff "function as the systems control (SYSCON)" for tactical information networks. Because of their operations and plans responsibilities, they function as an extension of the division Signal office. SYSCON functions include the design, engineering, and monitoring of systems and circuits,

and allocating and controlling the Signal battalion communications resources for the mission. The S3 recommends changes to equipment and personnel in the Signal battalion organization, and prepares and supervises the battalion's training programs.(11)

It is especially relevant to note that organizational force integration programs will strain the availability of Signal Majors to fill these critical positions. This will further provide challenges for the Signal officers within the division. Two such programs are the Joint Specialty Officer (JSO) and the Army Acquisition Corps (AAC).

The JSO is an officer having been trained for, selected for an assignment, or currently serving in a designated Joint Service position. The JSO program is a result of the 1986 Goldwater-Nichols Department of Defense (DOD) Reorganization Act. Title IV of the Reorganization Act establishes that the Secretary of Defense (SECDEF) designate a critical Joint Duty Assignment List (JDAL) which the services are required to fill. The intent of Title IV is to drive the services to fill the JDAL positions with quality officers in order to encourage service cooperation in implementing Joint warfighting doctrine.

Joint duty assignments will not jeopardize an officers chances for further promotions. "JSOs are expected, as a group, to be promoted at a rate not less than

the rate for officers of the same armed service in the same grade and competitive category who are serving on or have served on the headquarters staff of their armed service...."(12) The Army strives to assign its "best officers" into Joint duty assignments.(13) Since it may therefore be career enhancing to pursue duty as a JSO, many officers follow this career path.

The Army Acquisition Corps (AAC) officers are part of the Army's recently established Army Acquisition Corps. The AAC is also a result of the 1986 Goldwater-Nichols DOD Reorganization Act. The AAC is mandated by public law. The intent of the legislation is to streamline the materiel acquisition process by implementing the findings of the Packard Commission on Defense Acquisition. The purpose of the AAC is to "develop a dedicated nucleus of specialists in systems development, procurement, and logistics.... To acquire these skills, AAC officers must pursue a nontraditional career path."(14)

Pursuing a nontraditional career path means that officers in the AAC forego battalion and brigade level command. These officers spend little time in branch related tactical assignments.

Duty as an AAC specialist may also be career enhancing. Army goals for the AAC officers include 100% attendance to advanced civil schooling and specialized procurement related training. AAC assignments will not

jeopardize an officers chances for further promotions. Guidance to selection boards and assignment considerations for AAC officers are to:

> select first time considered officers ...at a rate not less than the selection rate for all first time considered officers; first time considered officers within each career field ...at a rate comparable with the overall first time considered selection rate for that same career field.(15)

Both these organizational force integration programs will impact on the quality and quantity of Majors assigned to the division Signal battalion, providing a significant personnel challenge. "These programs are congressionally mandated. Only those officers with above average [personnel] files will be sent to those assignments."(16) These organizational programs will stress a personnel system already overextended due to the existing shortages of Signal officers.

While "Signal shortages exist at all grades, [they are] most severe at [the] major and lieutenant colonel [grades]."(17) For fiscal year 1991, there are 883 personnel authorizations for Signal majors. Of a current inventory of 832, 629 are available for operational assignments. The JDAL contains approximately 150 positions for Signal majors-- the second highest branch requirement in the Army. The AAC steady-state inventory requires approximately 231 positions for Signal majors-- the highest of any branch in the Army.(18) Together these two programs have theoretically accounted for the top sixty

percent of all available Signal majors, and prevent assigning these officers to meet the challenges of the battlefield.

Each of these evolving force integration products will contribute to revolutionizing how the Signal officer and his staff support the maneuver commander and the unit in combat. Ultimately, the success of the Signal officer will contribute significantly to the success of the maneuver commander.

The Signal officer will face many significant challenges in the decade of command and control. The brief review of force integration programs provided an insight into the types of challenges that must be overcome. Many more of these challenges are still unclear or even unknown. Figure 3 is a depiction of how one may view a categorization of the challenges that face the Signal officer. These challenges are categorized by force integration program, and by C3 functional area.

There is a need for an in depth look into the cummulative impact of C3 force integration on the operations of the divisional Signal battalion-- down to the who-does-what level. This thesis is an attempt to answer some of these questions.

RESEARCH QUESTION. Will C3 force integration programs impact the division Signal officer? The answer to

this primary research question will become clear. At issue, however, is the impact on the division Signal officer and

C3 FUNCTIONAL AREAS

FORCE INTEGRATION AREAS

	PERSONNEL IMPACTS	EQUIPMENT IMPACTS	PROCEDURES IMPACTS	TRAINING IMPACTS
DOCTRINE: DESERT STORM LESSONS LEARNED AIRLAND OPERATIONS				
ORGANIZATION: IMA JSO AAC	CHALLENGES OF THE SIGNAL OFFICER IN THE DECADE OF COMMAND AND CONTROL			
ARCHITECTURE: BIA				
MATERIEL/EQUIPMENT: ATCCS: MCS AFATDS FAADS ASAS CSSCS EPLRS JTIDS ISYSCON				

Figure 3: CHALLENGES OF THE SIGNAL OFFICER IN THE DECADE OF COMMAND AND CONTROL

his ability to execute the mission. Specifically, the focus of this thesis will address the question of how the divisional Mobile Subscriber Equipment (MSE) Signal battalion S-3 operations are affected, in terms of C3 functional areas, by the introduction, use, and sustainment of new systems provided by force integration. Based on the staff responsibilities of the S3 to the DSO, as previously discussed, an adverse impact on the S3 will affect the DSO's organization, operations, plans, and training to support the division's C3.

DEFINITION OF TERMS. See Appendix.

ASSUMPTIONS. In preparing this thesis, an assumption is that all C3 force integration programs will be fielded and current fielding schedules remain in effect.

LIMITATIONS/DELIMITATIONS. Limitations are those constraints and restrictions beyond the control of the author that affect research. Two fundamental limitations will affect this thesis. First, the final product must be completed in the Command and General Staff College academic year as an individual effort. Second, the research effort is limited to the available research material. Delimitations are those constraints the author imposes on the thesis. Several delimiters are placed on the scope of this thesis based on an evaluation of the aforementioned limitations. Figure 4 is a graphical representation of the force

FORCE INTEGRATION AREAS	C3 FUNCTIONAL AREAS: PERSONNEL IMPACTS	EQUIPMENT IMPACTS	PROCEDURES IMPACTS	TRAINING IMPACTS
DOCTRINE: DESERT STORM LESSONS LEARNED AIRLAND OPERATIONS				
ORGANIZATION: IMA JSO AAC				
ARCHITECTURE: BIA				
MATERIEL/EQUIPMENT: ATCCS:				
MCS				
AFATDS FAADS ASAS CSSCS EPLRS				
JTIDS ISYSCON				

Figure 4: RESEARCH AREA OF INTEREST

integration programs that will be covered (shaded portions) in this analysis.

Doctrinal, organizational and architectural areas force integration programs are omitted from this effort. Within the force integration area of materiel, only three systems will be used for analysis: MCS, JTIDS, and the ISYSCON.

The efforts of this thesis' analysis will be limited to the standard divisional MSE Signal battalion; to cover each different type Signal battalions would be somewhat repetitive. Within the MSE Signal battalion, the S-3 section will be the area of focus for analysis. It is the fundamental organization supporting the divisional Signal officer which must integrate and facilitate the operations of C3, i.e., communications networks to support battlefield automation systems. It is at this level that there exist an adequate mix of 'hands-on' users and managers.

SIGNIFICANCE OF THE STUDY. Modernization through force integration is one of the principles which continues to guide the Army as it restructures to face the future. Command and control on the tactical battlefield, based on the fielding on the ATCCS will be the biggest force integration challenge the Army will face in the 1990s. C3 force integration will occur continuously at an extremely fast pace during the mid 1990s. There will be little opportunity for the leadership of a divisional MSE Signal

battalion to stand back, assess the situation, then gather and apply lessons learned to make C3 force modernization a smooth transition. This product can serve as a frame of reference from which the divisional MSE Signal battalion commander and S-3 can anticipate the challenges of the near term future.

CONCLUSIONS. The role of the Signal officer in the Army division has quickly transitioned during the 1980s from a provider of combat communications to an integrator and manager of communications/automation based C3 networks. Force integration changes to doctrine, materiel, organizations, and their supporting architectures are occurring simultaneously. Each program independently provides significantly new challenges to the Signal officer. Each supplies competing needs for the Signal officer's expertise.

There is a need for an in-depth look into the cumulative impacts of C3 materiel force integration on the operations staff of the divisional Signal battalion-- down to the who-does-what level. This thesis will identify the challenges to the Signal battalion S3 based on this rapidly changing tactical environment. Such an analysis must begin with a review of current literature to determine what is known of the challenges that come with C3 materiel force integration. This review of literature is the focus of the next chapter.

CHAPTER 1
ENDNOTES

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(6)U.S. Army Signal Center, _MEMORANDUM, Subject: IMA Implementation Plan_ (FT. Gordon, GA: U. S. Army Signal Center, 1990), 3.

(7)U.S. Army, _FM 11-50, Combat Communications within the Division_ (Washington: Department of the Army, 1991),2-7.

(8)William "Bill" Clingempeel, interview by author, Lansing, KS, 24 November 1991.

(9)_FM 11-50_ (1991), 2-6, 2-12.

(10)Ibid., 2-20.

(11)Ibid., 2-7, 2-22.

(12)Public Law 99-433, October 1986. _Title IV - Joint Officer Management Policy,_ Sec. 401 Joint Officer

Management, Chapter 38 Joint Officer Management, Paragraph 662 (a) (2).

(13)Memo, Secretary of the Army to President, FY 1991 Lieutenant Colonel, Army, Promotion Selection Board, 6 May 1991, SUBJECT: Selection Board Instructions. 10

(14)Ibid., 8.

(15)Ibid., 9.

(16)Jane Maliszewski, interview by author, FT. Leavenworth, KS. 5 October 1991.

(17)Briefing, U.S. Army Signal Center, The State of the Signal Corps Given at FT Leavenworth, KS, 8 August 1991.

(18)Ibid.

CHAPTER 2

REVIEW OF LITERATURE

INTRODUCTION. This chapter serves to provide the reader with a brief annotated bibliography of the references used to support this thesis as well as an early survey into the current state of knowledge in the subject area from which to transition into the methodology of research of the following chapter. Additionally, the literature review serves to identify the areas where a literature search failed to provide insight into the challenges that confront the Signal officer based on C3 force modernization.

There are currently many publications that provide the details of every force integration program this thesis will identify. Research reveals few, if any, publications, current or future, that either consolidates the efforts of all the programs, or provide leadership awareness on their cummulative effects on the operations in an MSE Signal battalion.

The review of literature below follows a thought process similar to that used for the analytic procedure in the next chapter. The literature reviewed initially provides references for the path the Army is following in

force modernization. It begins with the references which describe the force modernization process, and define the battlefield of the future, including emphasis on C3 modernization. Next, the references that describe the current operations of the Signal battalion S3 are reviewed. Those references which describe the force modernization implications in general, and those applicable to the three systems analyzed in this thesis are reviewed last.

Researching these current bibliographical publications such as those discussed below should provide sufficient insight from which to conduct analysis as outlined in the previous chapter.

SUMMARY OF LITERATURE. How the Army Runs is a chapter out of the Command and General Staff College Student Text 25-1 used in the Fundamentals of Resource Management course of instruction. The chapter describes summarily the Army's Life Cycle Model. This model describes the development, acquisition, distribution, deployment, sustainment and separation of materiel and units to support the national goals established for the Army by Congress and the President. The chapter briefly describes concepts such as force developments, materiel acquisition, the combat developments, the life cycle systems management model, the manning and planning, programming, budget execution system (PPBES) processes used in the Army. This article provides

the background on the force modernization sections of this thesis.

The document that best describes the future battlefield is TRADOC PAM 525-5, Airland Operations. It is a Joint Army/Air Force operational umbrella concept that describes the envisioned methods of warfighting and operating on the future battlefield. The concept serves as the baseline for the next update of the Army's capstone warfighting doctrine contained in Field Manual 100-5, Operations, Joint warfighting procedures, and Joint air attack action plans. This next update of FM 100-5 is due in late 1992. The concept pamphlet covers topics including the changing environment and threat of the unknown and its impacts on the Army, the umbrella concept for warfighting and operations short of war. Enabling warfighting concepts, such as responsive C2, range extension, and Joint and Combined C3 interoperability are expressed-- but no implementation specifics are provided. Implications for materiel, doctrine, organizations, training and leader development are stated in only general terms.

The reference describes the four stages of Airland Operations. These four stages are detection/preparation, establishing conditions for decisive operations, decisive operations and force reconstitution. All four phases are C3 intensive, but significantly, detection/preparation and rce reconstitution are dependent on the technological

advantages of automation and communication applications for successful execution.(1) The Signal officer and soldiers have always been challenged to be the first in the field and the last out to provide a means for the execution of C3; Airland Operations demands more of the same challenges.

The enabling concepts for responsive C2 are being implemented now in the Army. The Army Command and Control Master Plan (AC2MP) Executive Summary (AC2MPES) is a top level descriptive introduction to the AC2MP. It provides a cursory review of the enabling concepts, architectures and definitions of command, control, the ATCCS, Force level control system (FLCS), and interoperability. The AC2MPES provides a roadmap through the subsequent three volumes of the AC2MP.

C4000, Lesson 11, Contingency Force Operations, Command, Control, Communications, and Synchronization is a Command and General Staff College class handout used to describe Corps level C3 before, during, and after contingency operations. In doing so, it provides an introduction to the ATCCS, the corps communications system, MSE, C2 of forced entry operations, command post imperatives and the impacts of MCS on C2. Covered in an almost product marketing format, the handout stresses that MSE and MCS will serve to improve the C2 process and information exchanges in contingency operations. It's basic utility to this thesis

is for the definitions of acronyms and systems, e.g., ATCCS and MCS.

It is not a simple task to describe how the Signal battalion currently operates. Within the bounds of doctrine, the leadership of any particular battalion has the flexibility to implement the commander's individual leadership style. Command climate, priorities, unit location, and division of subordinate leader's responsibilities can all influence operations.

In order to standardize the impacts of such intangible influences, the majority of the research material on how the Signal battalion S3 does his job currently comes from field manuals, interviews, and procedural manuals.

C3 support by the Signal battalion to Airland Battle (ALB) is discussed in FM 11-30, MSE Communications in the Corps/Division, and other field manuals in the MSE series. FM 11-30 is the capstone manual in the MSE series. It discusses communication support with MSE for C2, as well as for combat support and combat service support units.

Four challenges of C3 support for ALB are made at the introduction of FM 11-30. These challenges, covered in one page, for C3 support are to (1) help convey the maneuver commander's tactical intent, through (2) the use of flexible and reliable communications. The challenge of (3) automating the planning and operations processes is mentioned without discussion. The final challenge is to be

tactically and technically proficient-- the classic doctrinal leadership competency.(2) There is no characterization of challenges, in terms of C3 functional areas in the FM. This, however, is not considered a deficiency because of the extensive materials available on how to do business with MSE in the MSE series of field manuals.

The C3 assets available with MSE are discussed for corps and division in terms of major nodes and switching equipment provided by elements of the corps Signal brigade and divisional Signal battalion. The FM continues to discuss MSE employment characteristics and the limited information about the functions of network management and the SYSCON. Staff responsibilities and SYSCON information flow between staff elements and introduced to describe how the MSE System Control Center (SCC) provides the facility to control the MSE network. Although this limited network management information is used to describe systems operations, it does not provide the necessary detail to understand how the Signal battalion S3 executes network management on MSE. Instead FM 11-30 refers to FM 11-38, MSE Management of Control for such detail.

FM 11-38 does provide adequate detail on MSE network management. Although specifically stated duties of the Signal battalion S3 are not discussed per se, FM 11-38 does detail network management functions of the S3 in terms

of the characteristics of MSE. Beginning with an introductory MSE architectural overview, it discusses briefly the doctrinal impacts of the area supported MSE communications architecture and centralized network management. The importance of an uniform corps-wide network is stated.

Technical impacts of MSE focus on the fact that MSE hardware and software determines call routing and switching characteristics. Previous to MSE, signal planners and operators were required to configure systems to determine these characteristics.(3) The idea is that technology (through force modernization) made the Signal planners job easier.

FM 11-38 does, however, provide technical (read subject matter specific-- not scientific) information on the MSE switching data base and frequency management requirements. The majority of the field manual is related to network management (NM) operations during network deployment.

NM operations are discussed in four distinct phases: predeployment, installing the backbone, installing extensions and operational management.(4) The details of this four phased network management operation serves as the basis for introduction to analysis. It will be used to describe what the S3 currently does in order to assess the impacts of force modernization.

FM 11-37, <u>MSE Primer for Small Unit Leaders</u>, is the final reference in the MSE FM series. It discusses MSE system features and equipment characteristics. Duties of the equipment operators, by MOS and by organization/section are listed. The Primer also discusses logistical support and communications security operations and maintenance.

<u>FM 11-50, Combat Communications Within The Division (Heavy and Light)</u> describes Signal support doctrine in Army Heavy, Light, Airborne, and Assault divisions. The FM covers the organization of the divisional non-MSE Signal battalions in each type division and maneuver communications down the major subordinate commands of the division, including separate company/detachments. Functions of Signal support, such as automation management and the responsibilities of key personnel are specified in the publication. The FM includes useful appendices that detail Signal personnel in maneuver brigades and battalions, and in the division artillery, Signal site defense, interoperability with MSE corps/divisions, and the IMA Implementation Plan, as do most other Signal field manuals. The information from this reference is used to help describe how the Signal battalion operates presently, prior to applying force modernization changes.

Research can never substitute for first hand experience. This is the premise behind the <u>Interview with William (Bill) Clingempeel</u>. When documentation and

experience failed to present a clear picture of how the S3 supported C3, these interviews with a former S3, ADSO, XO, and Acting Signal battalion commander served to fill the void.

The references which describe and implement force modernization programs were used to gain insight into the challenges that are to come. Although the analysis will focus on three materiel systems, procedural and organizational documents were also researched.

In the TOE Handbook 11065L-CTH, Commander's TOE Handbook, Division Signal Battalion (MSE), the unit's 'living' Table of Organization and Equipment (TOE) is outlined. The TOE includes a listing of personnel and equipment requirements for the unit. Any particular unit's actual authorizations are documented in the unit's Modified TOE (MTOE). The differences between the TOE and the MTOE may sometimes be significant. Incremental Change Packages (ICP) are itemized to show the changes in requirements based on the fielding of new materiel.

The Tactical Standing Operating Procedures (TSOP), Armored and Mechanized Division is provided as a CGSC generic SOP applicable to any heavy division. It is intended to provide an example of an SOP used to standardize routine, recurring operational procedures and responsibilities for normal actions in a heavy division. The TSOP covers topics such as CP procedures, control

methods, liaison offices (LNO's), and succession of command. Operations such as nuclear, biological, chemical (NBC) and road movements are covered i significant detail, but Signal operations/Signal supported unit responsibilities are only generic. It was anticipated that the reference, being a schoolhouse text issue, would provide insights into future force modernization efforts. It did not.

In his Briefing, The State of the Signal Corps, the Signal Center Chief of Staff provides an update on several personnel issues which impact on Signal branch. Promotion rates, personnel inventories and assignment statistics were presented to provide insights into personnel proponency issues. The significance to the thesis of this update is that it provides a single forum for exposure to future officer and enlisted personnel programs which impact on the Signal battalion.

An Interview with Jane Maliszewski revealed the institutional practices and personal experiences of a former assignments officer of the selection and nomination of the officers in programs such as the Army Acquisition Corps (AAC) and the Joint Specialty Officer (JSO). Both personal and perceived institutional insights on the impacts of these programs resulted from the interview. The legal requirements for these programs are published in Public Law 99-433, Title IV-Joint Officer Management Policy.

The institutional insights of the AAC and the JSO provided in the interview are substantiated in the Secretary of the Army, Memorandum For President, Fiscal Year 1991 Lieutenant Colonel, Army, Promotion Selection Board. This reference is the guidance and instructions to the Lieutenant Colonels promotion board. The same guidance has subsequently been provided to every Army promotion board held since.

The Army Command and Control Master Plan, Volume I: Desktop Reference is the unclassified portion to the three volume set. It assigns responsibilities for C2 in the Army, including the proponency of doctrine, training ,systems and leader development. Volume 1 is published every two years in order to provide a current update on Army requirements. Topics covered in detail include the ATCCS (ECB C2), theater Army C2 developments, and general topics of C2 development--current and future.

When the three systems of interest to this thesis are described, little usable information is provided. Vol I makes no mention of leadership issues on JTIDS or MCS. For ISYSCON, the entry reads "N/A" for leadership and "TBD" for doctrinal issues. Vol I does elaborate the contractor will develop JTIDS training for the Army. It only briefly mentions that units will use the fielded system for training without any additional information.

The Master Plan does provide insights into future C2 doctrinal and training implications of force modernization will require precise, sound and synchronized doctrine, tactics, techniques and procedures (TTP) and SOPs. Training, in turn, will become more critical as individual tasks and systems increase in technical and operational complexity and fewer individuals are available in a downsized Army. As systems begin to interact with each other, individuals will be required to understand more about how their tasks affect the overall C3 framework.(5)

The school system will teach their own proponent systems, as well linkages to other systems. Units, nonetheless, will require innovative training, day-to-day, to reinforce such techniques and system linkages. One major challenge the Master Plan addresses is the tradeoff between leadership desire for long duty assignments for personnel which perform complex tasks proficiently, and the leadership responsibility to assign personnel to a variety of assignments for professional development.(6)

In order to understand how this personnel rotation issue comes to being, an explanation of C2 automation key personnel is needed. The Army Tactical Command and Control Systems (ATCCS) Management concept provides the framework for this explanation.

The ATCCS Management on the Airland Battlefield document describes a concept for executing the battlefield

management of the systems of the ATCCS, including FLCS management, BFA management, and WAN management. The premise of the concept is the notion of user owned and operated communications and automation equipment doctrinalized through the implementation of the IMA into the tactical world. The paper serves as a catalyst for the development of doctrine and procedures for using and managing the battlefield automated systems of the ATCCS.

Beyond the introduction of new automation-based vocabulary, the concept capitalizes on the basic staff relationships and interaction introduced in <u>FM 101-5, Staff Organization and Operations</u>. For the purposes of this thesis, and understanding ATCCS management in general, it is imperative to summarize key definitions and duties introduced in the reference. These are described below-based on such necessity. Traditional tactical staff examples are used for clarity.

The four areas of ATCCS management are personnel, training, maintenance and use of automation management tools. ATCCS management is the operational planning and execution of network functionality. It consists of four hierarchical elements: force level control (FLC) management, battlefield functional area (BFA) management, subordinate system (S2) management and WAN Management.(7)

FLC managers direct the five BFA C2 systems in their utility towards force level integration, i.e., how does fire

support or CSS support the scheme of maneuver. BFA managers control and direct functional C2 systems in configuration, control, and status monitoring /effective use, i.e., how well is the intelligence collection plan working in a particular brigade's area of the division. S2 management is similar to BFA management, but adds the duty of providing user assistance, i.e., given that are defense control measures for the division is "weapons free", how does the operator tell subordinate units to minimize multiple engagements. WAN management is the integration and control of the WAN in support of ATCCS C2 systems, i.e., which communications rigs of which C3 system does the Signal battalion employ in support of a maneuver brigade using MCS and ASAS.(8)

Routinely, these management tasks are envisioned to be assigned specifically as follows with in any particular command post (cp) from battalion to corps levels. The G3/S3 is responsible for overall ATCCS operations. The FLC manager is the assistant S3 or operations NCO. The BFA and S2 managers are designated by the senior person of the specific BFA. Operators are the specific individual responsible for a single terminal of a BFA or S2 C2 system.

As for Signal battalion personnel, the ADSO has technical staff oversight responsibility to the G3 for FLC management. He validates user requirements for integration

of C2 systems with the WAN with in the division. The division Signal Battalion S3 is the WAN manager.(9)

Traditional staff relationships have not changed to accommodate ATCCS management. New terms do again merit discussion. Three staff relationships are significant: operational support, BFA (or C2) technical support and C3 technical support.

An example of operational support is G3 to S3 between echelons, or S3 to S3 within the same echelons, or S2 to S3 within the same CP. BFA technical support examples include an operator to a BFA or S2 manager. C3 technical support examples include a unit to its Signal officer, the unit Signal officer to the ADSO, and the ADSO to the Signal battalion S3.(10)

An understanding of the ATCCS Management principles ties together the notion that new materiel of the ATCCS provides personnel, equipment, and leadership challenges. In this thesis, the Maneuver Control System (MCS), the Joint Tactical Information Distribution System (JTIDS), and the Integrated System Control (ISYSCON) are the materiel systems at issue.

A ready reference on C3 systems discussed in the analysis of this thesis is the U.S. Army Signal Center Directorate of Combat Developments Program Summary Sheets. It provides programmatic information (cost, budget, status) on selected C3 systems planned for introduction/fielding in

the Army. ISYSCON, JTIDS and the Battlefield Information Architecture (BIA) strategy are discussed in this reference. The Program Summary Sheets could provide Signal battalion leadership the information about when systems are planned for fielding.(11)

The 52d Division (Mechanized) Field Standing Operating Procedures (FSOP), Maneuver Control System (Version 10.3) is a contract deliverable document which describes how the system can be used in a notional divisional environment. The document serves as a basis for the development of actual Army division FSOP. This document provides an overview of the MCS and discusses staff responsibilities for use of the system.

The Doctrinal and Organizational Test Support Package (DOTSP) for the Joint Tactical Information Distribution System (JTIDS) is a test and evaluation support document. The DOTSP discusses the means of employment for JTIDS, as a component of the Army Data Distribution System (ADDS) communications architecture, in support of the ATCCS' C2 systems. To do so, much discussion involves the specifics of how the supported C2 system (FAAD C2) support the Air Defense BFA.

The DOTSP for JTIDS discusses network management (NM) operations for the system in ten basic steps. The details of the NM operations are used for the analysis of

how the S3 in the Signal battalion is impacted by the JTIDS force modernization program.

The Operational and Organizational Plan (OOP) for the Integrated System Control (ISYSCON) and the Required Operational Capabilities (ROC) for the Integrated System Control (ISYSCON) are two of the principle (and maybe only) reference documents that discuss operational employment considerations. Both are programmatic documents. It is from the ROC and OOP for the ISYSCON that the analysis of this thesis is conducted. C3 force modernization challenges are left to the informed reader.

The OOP is the first programmatic document of the two, chronologically. It discusses in operational terms what the ISYSCON is intended to support on the battlefield. Organizationally, it discusses where on the battlefield it is intended to be employed, e.g., which units will receive the system. The OOP also outlines the need for the ISYSCON, its operational/technical characteristics, and the envisioned maintenance and support concept for the system. Interoperability considerations of the system design are a required section of the OOP.

The ROC for the ISYSCON is the second of the two programmatic documents. The ROC is a one page basic document, but the accompanying rationale annex, used to describe why specific system characteristics are required, is much more specific about operational considerations of

the system. The ROC specifies required system characteristics, and addresses organizational and operational issues with single sentence entries.

The OOP for the Family of MCS of the Family of ATCCS provides similar type information for the MCS as that for ISYSCON. The MCS system is already fielded to a majority of Army units. ISYSCON has still not been built. Therefore, the OOP for ISYSCON is more significant to this research effort than the OOP for MCS.

CONCLUSIONS. In this chapter, the references used for research were reviewed. There is much information available to describe how the MSE Signal battalion S3 does his job. There is also much information available that discusses the force modernization programs that will soon be fielded, including organizational and materiel systems.

It is envisioned that in the future each of the systems projected for fielding will be well documented. Series of field manuals and SOPs will be available to discuss the implementation and use of these systems, similar to those available for the MSE system. For the present time, however, there is a gap in the literature available to understand the implications of the cummulative C3 force modernization effort.

A need, therefore, exists to fill the void that addresses how each system interacts with the other, and how

to lead the Army through the challenges to effectively use a comprehensive C3 framework.

In the next chapter, a framework for analysis is provided to identify such challenges of the Signal officer in the decade of command and control.

CHAPTER 2

ENDNOTES

(1)U.S.Army Training and Doctrine Command, TRADOC PAM 525-5 --Airland Operations (FT. Monroe, VA: 1991), 16.

(2)U.S. Army, FM 11-30, MSE Communications in the Corps/Division (Washington: Department of the Army,1991), 1-4.

(3)U.S. Army, FM 11-38, MSE Management and Control (Washington: Department of the Army, 1991), 1-4.

(4)Ibid., 4-2.

(5)U.S.Army Combined Arms Combat Development Activity, Army Command and Control Master Plan,Volume I, Desktop Reference 1990 (U.S.Army Combined Arms Combat Development Activity, 1990), 7-8.

(6)Ibid., 7-10.

(7)John M. Blaine, "ATCCS Management on the Airland Battlefield (3d Edition)," (U.S.Army Signal Center, 1991), 4.

(8)Ibid.

(9)Ibid., 5.

(10)Ibid., 11.

(11)U.S.Army Signal Center, "Program Summary Sheets," (FT. Gordon, GA.: U.S.Army Signal Center Directorate of Combat Developments, 1991), Foreword.

CHAPTER 3

A FRAMEWORK FOR ANALYSIS

INTRODUCTION. This chapter describes the research methodology. It provides the means for the reader to understand the approach for conducting analysis.

This chapter describes why the specific systems fielded to the Army through force integration will be used for analysis, and why others are omitted from this study. It describes the procedure for identifying current operating procedures in the divisional MSE Signal battalion, including the use of personnel, equipment, and training, and how the changes to current operations will be measured to determine their impacts on current operations.

The criteria for analyzing the impacts of employing new systems on current operations will be defined in terms of C3 functional areas. Figure 5 is used to provide the reader a visual representation of the analytical research methodology as a foundation for analysis.

C3 FORCE INTEGRATION. Force integration programs included in the analysis are the ATCCS' MCS, the JTIDS communications system, and the ISYSCON wide area communications management system. Each was chosen based on

C3 FUNCTIONAL AREAS

FORCE INTEGRATION PROGRAMS	PERSONNEL IMPACTS	EQUIPMENT IMPACTS	PROCEDURES IMPACTS	TRAINING IMPACTS	LEADERSHIP IMPACTS
MANUEVER CONTROL SYSTEM (MCS)					
JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM (JTIDS)					
INTEGRATED SYSTEM CONTROL (ISYSCON)					

Figure 5: THE ANALYTIC MATRIX

their significance to how the Signal operations officer, and therefore the divisional Signal officer, supports the battlefield commander.

Figure 5 shows the analytic matrix. Figure 5 is an enlargement of the depiction of the Signal officer's challenges shown earlier in Figure 3, showing those portions of Figure 4, research area of interest, that were shaded.

The Maneuver Control System (MCS) will be presented primarily as an example of user automation systems because of its widespread impact across the division. The S3 is a system user of MCS. Based on the relationship between the S3 and the ADSO/Assistant G6, and therefore the division automation officer, the S3 is involved in the signal support of the MCS network.

The Joint Tactical Information Distribution System (JTIDS) will be used as a representative new communications system fielded which will impact the on the operations, training, and planning aspects of the divisional Signal battalion. The system is less complex in operational employment than other new communication systems, and therefore, lends itself to this thesis for analysis. The S3, and more specifically, the SYSCON, are the network managers of the communications system.

The Integrated System Control (ISYSCON), the communications and automation management facility of the ATCCS system, is planned for fielding primarily for the

Signal battalion S-3. The S3 is both a user and a manager of this automated system.

Doctrinal force integration issues such as Air Land Operations will still be evolving when this thesis is completed. Organizational force integration programs such as the Implementation of the Information Mission Area will be flourishing on the tactical battlefield. These programs, and others are dynamic. But, as discussed previously, these areas of force integration will not be covered in this thesis. Although other programs are not specifically included in this effort, the impacts of fielding such like systems can be extrapolated from the results of this thesis. Nonetheless, each of these other force integration programs is important. Each will change how the supporting Signal organization does its job.

PROCEDURE. The procedure for 'measuring' the qualitative impacts of C3 materiel force integration is performed in two steps; describing current Signal battalion operations, then assessing changes required to current operations by the fielding of new systems. The 'measurements' (read changes in duties, procedures, functions, etc.) are assessed both objectively and subjectively. These changes are categorized according to the criteria to assess cummulative impacts of C3 force integration.

The current operations of the Signal battalion S3 and his subordinates are described. The staff section organization, personnel, equipment, duties, functions, and responsibilities are outlined with respect to the C3 mission and traditional leadership roles. References used to describe current operations include standard generalized SOPs, the Signal battalion TOE, doctrinal references and interviews. The intent is to demonstrate manpower and workload requirements prior to the introduction of new systems.

The changes to current operations experienced by the S3 and his subordinates based on the requirements for fielding each new system are documented as a result of analysis and categorized as impacts according to criteria--the C3 functional areas.

CRITERIA FOR ANALYSIS: C3 FUNCTIONAL AREAS. Figure 5 shows the C3 functional areas used as criteria. For each new system, personnel, equipment, procedural, training, and leadership changes will be extracted from the references, and categorized under these C3 functional areas. The cummulative effort expected in each of these C3 functional areas will be the impacts of using the new systems as related to the Signal battalion S-3.

The type of issues answered from the research include how to use new personnel or current personnel on a new system, whether the system provides new software or

procedures to do a current mission, institutional and unit training, whether procedures must be developed, changed, or augmented by new requirements, and significantly, what leadership implications exist in terms of supervisory, authoritative, or management responsibilities. The intent is to determine the total C3 perspective when the individual systems impacts are combined to show the cummulative changes in manpower, workload and responsibilities of the S3.

CONCLUSIONS. In this chapter, a simple research methodology is presented to identify the challenges of the Signal officer. Simplicity is the biggest strength of this methodology. The use of a decision matrix for analysis makes the methodology comprehendible because in the academic military environment, it is a quasi-standard analytical tool. The weakness of a decision matrix as an analytical tool resides in the quality of the evaluation criteria. The use of well defined evaluation criteria for this decision matrix serve to limit the weaknesses of this research methodology, thus providing a sound foundation for analysis.

In this thesis, the research methodology described herein will be applied using the information found in the references reviewed in the previous chapter. The application of this research methodology is the focus of the next chapter.

CHAPTER 4

DISCUSSION/ANALYSIS OF COMMAND, CONTROL, COMMUNICATIONS FORCE INTEGRATION PRODUCTS

INTRODUCTION. In this chapter the research methodology is applied, as described in the previous chapter, in a simple and structured manner to take the reader to the most obvious conclusions as it results from the analysis. In essence, this chapter is used to fill in the cells of the matrix presented during the previous chapter.

The chapter initially describes the current operations of the divisional Signal battalion S3. The discussion of each materiel force integration system will begin with a discussion of the system overview and means of employment followed by the analysis of C3 functional area impacts. The conclusions of this chapter summarize the cummulative impacts of all systems by C3 functional area in order to form conclusions and recommended courses of action.

CURRENT SIGNAL BATTALION OPERATIONS.

MSE is the Mobile Subscriber Equipment. It is one part of a three-part force communications architecture, as discussed in chapter one in the review of the Army Tactical

Command and Control System (ATCCS). While battlefield users require three types of tactical C3, MSE will carry the vast majority of the voice and data traffic for these units to support C2 and sustainment operations, and hence, represents the majority of the Signal officers communications mission.

The MSE design and architecture is representative of a sound, large-scale, Corps-wide automation-based distributed network with many users and shared user/provider responsibilities. This type of architecture also describes the three systems analyzed in this effort: Maneuver Control System (MCS), Joint Tactical Information Distribution System (JTIDS), and the Integrated System Control (ISYSCON). Therefore, MSE, as a corps-wide network, will be featured in describing current divisional Signal battalion operations.

In a stand-alone division, key Signal battalion personnel and staffs are responsible for divisional C3, and therefore, assume additional responsibilities normally conducted at corps level. The division signal officer assumes responsibility for advising the divisional commander, staff, and units on Information Mission Area (IMA) matters. These matters include using signal troops, communications facilities availability and augmentation, communications security (COMSEC), and how the divisional command post (CP) locations affect communications. This information is coordinated according to division SOP. In the stand-alone mode of operation, "the division signal

officer takes on more responsibility as every combat operation requires detailed signal planning and coordination".(1)

MSE operations consist of five functional areas: Area coverage, wire subscriber access, subscriber terminals, mobile subscriber access, and systems control. The first four describe equipment and capabilities available for C3. "The fifth provides the signal commander with facilities to C2 MSE assets and the operational responsibilities of the S3".(2)

The basic building block of the MSE network is the node center (NC). Each NC consists of one node switch (NS), including an operations group shelter and a switching group shelter, one node management facility (NMF), four line-of-sight (LOS) radio assemblages, two radio access unit (RAU), and associated generators and support equipment. The NCs are the hubs of the MSE switched network providing internodal connectivity. The NS is the 'brains' of the NC. It provides automated switching and network access to local subscribers (node and network management personnel) and to mobile subscribers through the RAU and for extension switches. The division establishes links to adjacent division(s) and the corps. NC deployment is based on an area coverage concept, terrain restrictions, LOS requirements, and network interconnectivity requirements.(3)

Subscriber equipment for the MSE is primarily user-owned-and-operated. All signal personnel are responsible for customer education and satisfaction. They must ensure their subscribers have reliable and responsive communications. The brigade/battalion signal officer (BSO) performs a critical function for signal network managers. The BSO ensures-- users are trained, the network is fulfilling customer needs, proper coordination, subscriber problems are accurately identified, and that troubleshooting is a coordinated effort.(4)

Prior to MSE force modernization, signal planners and switch operators used non-MSE equipment to determine switching routes, number and type of trunks (analog versus digital). These decisions were based on equipment characteristics and limitations. The planning and engineering processes were intense and technically difficult. However, these processes were needed to support the initial networking and reconstitution of separate 'stovepiped' systems. In a corps-wide MSE system, the hardware and software determine call routing, switch trunk capacity, and signaling characteristics. This allows signal planners to manage more assets with less people. Only in special cases (such as non-MSE gateways) do signal planners make these decisions.(5)

The corps signal brigade S3 manages and controls the corps MSE network with the corps SCC. The primary SCC

performs all automated network planning, systems engineering, network management and control, and dynamic operational planning of MSE personnel and equipment for the corps. When in a corps network, the division SCC functions in an active role but remains under the 'technical control' of the corps' primary SCC. The movement and placement of NCs are closely coordinated between the supported battlefield user and the supporting signal provider. The actual movement of these assets on an area basis is under the control of the respective division and corps signal battalion commanders. The corps signal brigade is responsible for maintaining network integrity, coverage, and service throughout the battlefield by reallocating nodes, trunks, extension assets, and area of responsibilities.(6)

The system control center (SCC) is the primary signal C2 facility for MSE network operations. Currently the SCC-1 is in the field. The SCC-2 will be fielded in 1992 and will completely replace the SCC-1. The SCC consists of a technical shelter and a management shelter. When the division deploys independent of the corps, the management/control element is in the headquarters of the division signal battalion. The division SCC assumes the role of primary SCC when deployed without corps SCC support.(7) For the purposes of this study, the divisional Signal battalion will be autonomous.

The SCC automates many signal planning and engineering functions. These include profiling, producing communications annexes for operation, frequency management, some network, equipment/team status and COMSEC functions. Signal C2, like C2 in general, still depends on exchanging information between all signal staffs.(8)

The SCC deploys and collocates with an NC and gains network connectivity through the NS. The SCC is normally connected to the NS by a 0.25 mile coaxial cable. The node management facility (NMF) provides the node commander (a platoon leader) a shelter from which to direct nodal operations. The NMF contains the AN/UGC-74 data terminal used for sending reports to and receiving orders from the SCC. The NMF is the network interface between the S3/SCC, the NCs, and extension nodes.(9)

By doctrine, MSE is a corps managed and controlled communications system. Some of the responsibilities and relationships that exist between corps and division signal staffs need be addressed to understand divisional signal battalion operations when deployed autonomously.

The staff members at corps and division each have specific functions aimed at providing a portion of the corps network. The information they provide is given to the S3 where the SCC computer-assisted tools collate, store, and retrieve this information as needed.

The S3/SYSCON directs the MSE area communications system and subordinate signal battalions at corps and division. Centralized corps SCC control ensures network integrity and economy of force. It is consistent with corps support doctrine, and satisfies the personnel constraints on the size of the divisional signal battalion.

Responsibilities and duties must be established between the corps SCC and the division SCC because of the common automated management functions of the SCC. Doctrinally, the divisional S3/SCC is responsible for NC's, extension nodes, and RAU's within the division area, and LOS frequency management for the division. The corp SCC is additionally responsible for corps area network management and control, LOS link management, gateways to strategic, joint, allied and commercial networks and corps-wide COMSEC key generation, management and distribution. In a stand-alone division, the divisional S3/ SCC assumes all responsibilities.

The MSE network manager/controller is the regulator (authority and implementer) of network operating parameters, including frequencies, COMSEC, nodal connectivity, interfaces, and network software. This is the essence of technical control. The corps signal brigade staff provides guidance for corps communications network implementation. Staff sections are organized to plan and implement communications network design, operational control (OPCON),

and administrative and logistics direction. The staff uses the corps communications plan taskings to develop the communications network. Proactive monitoring of the network's operational status ensures that it meets the corps' changing requirements. These responsibilities belong to the operation/intelligence section, in the brigade headquarters, which consists of four staff elements: corps signal engineering branch, network control branch, plans/intelligence section, brigade COMSEC office of records.(10)

The corps signal engineering branch is part of the S3/SYSCON for the brigade and operates from an AN/MSC-25 shelter. Significant functions include integrating allied, joint, and commercial communications into the network, maintaining direct coordination with the SCC/SYSCON in the network control branch, disseminating current and future operational plans throughout the corps communications network, network control, and network analysis. The branch is manned by two majors, four captains, and a chief warrant officer (WO).(11)

The network control branch of the corps Signal brigade provides the two SCC's for the corps-wide network. Its functions include automated frequency management, LOS path profiling, automated system engineering, equipment status reporting, LOS link and network loading status and COMSEC key management. The branch is manned by one major,

five captains, four lieutenants, and E-9 operations noncommissioned officer (NCO), four each E8 SCC supervisors, E7 network controllers, and E6 SCC operators, and three E4 clerk typists.(12)

The plans/intelligence section provides the planning, coordination, and supervision of plans and intelligence requirements for the brigade. Key personnel includes one major and one captain as plans officers, a major as chemical officer, an E8 operations NCO, one E8 nuclear, biological, and chemical (NBC) NCO, an E7 plans NCO, an E6 intelligence analyst, two E4 clerk typists, and an E4 graphics document specialist.(13)

The corps' signal battalions provide signal facilities that support plans developed by the corps signal staff and the corps signal brigade staff to support unit communications requirements. The corps area signal battalion's operations/intelligence staff section coordinates the installation of six NCs, 41 extension nodes, and 13 RAUs. The corps signal support battalion's operations/intelligence staff section coordinates the installation of four NCs, 25 extension nodes, and eight RAUs. The corps SCC generates the orders to deploy these assets, but the respective S3 sections oversee execution of those orders.

The division signal battalion includes two area signal companies and a signal support company that provide

four NC's, 17 extension switches, nine RAU's, one SCC, and associated assemblages. In the future, the division signal battalion will be increased to six NC's (and associated with other MSE nodal equipment).(14)

The division signal battalion's functions are similar to those at corps, but the staff has significantly less manning. The operations/intelligence section of the signal battalion is headed by the S3. Key personnel and responsibilities of the section are detailed below.

The assistant S3, a Captain, is responsible for the operation of the section. He plans and coordinates staff supervision of plans, requirements, and the battalion training programs.

The Lieutenant (LT) systems integration officer (SIO) manages force integration of information systems resources and plans battlefield automated systems (BAS) and information systems WAN integration. The SIO provides staff supervision of software support and troubleshooting of automated systems. The SIO manages ADP related areas including monitoring of unique 'application program' development and supervising maintenance of tactical data bases, and plans MSE network data base integration.

The tactical automated network technician is a WO. He assists the systems integration officer, and plans, designs, and manages the switching networks (to include COMSEC key management), and the integration and

interconnectivity of tactical and nontactical information networks and communications systems.

The E8 operations NCO provides technical assistance, supervises, and assists in communications system control and supervises the work activities of other enlisted personnel assigned to the section. The E7 network controller and the E7 MSE supervisor are responsible for the 24-hour SCC operation. Two E6 MSE SCC operators provide 24-hour systems operation.

Additional personnel include the E7 NBC NCO, an E5 intelligence NCO and two E4 clerk typists. An E3 MSE transmission systems operator is responsible for operating and maintaining the assistant S3's vehicle.(15)

The traditional requirement for establishing and controlling communications remains from higher to lower, left to right, and supporting to supported. With MSE, these requirements go beyond simply establishing network connectivity. The element in the higher, left, or supporting category also supplies equipment, coordinates frequency plans, COMSEC, software, and network control mechanisms. Corps signal elements will be scattered throughout the division area. Divisional signal elements will support other divisions; thus, signal unit areas become interlocked and interconnected.(16) The corps commander will fight C3 assets much like maneuver elements of the corps are fought.

The network manager is responsible for continuous area coverage throughout the corps area. Divisions will often require augmentation. The corps is responsible for providing more assets to ensure area coverage. Doctrinally, this requires two nodes. The division employs its assets to support C3 and to conform with the technical direction of the corps network controller. In a fully deployed corps, the division signal officer does not exercise network control over divisional assets. The corps network controller controls all assets. Close coordination between the corps and division signal officers is imperative.(17)

The MSE network is deployed in four phases. The S3's management role in each phase in terms of using the MSE SCC are as follows. Predeployment (Phase I) activities include long lead time activities and short lead time activities. Installing the backbone (Phase II) includes monitoring reports from NCs teams about internodal links and directing the bulk transfer of COMSEC key lists to 'leader' switches. Installing extensions (Phase III) includes ensuring RAUs are installed first to support mobile subscribers traversing the battlefield, and that NMFs generate a 'request frequency plan' message for each RAU to initialize the system. Reports are monitored to verify that extensions are installed by priority. The operational management phase (Phase IV) includes maintaining close coordination between the G3/S3, ACSO/ADSO, BSOs, SYSCON,

network technicians, NMFs, and team chiefs to provide a network that best serves the C3 needs of subscribers. It is relevant to discuss these phases in detail to understand the current operations of the operations staff.(18)

The most influential steps of network management and control take place through planning. Planning decisions determine the grade and type of C3 services provided, and include long lead time actions. The SCC and NS's operate from a standardized network data base. The critical part of long-range planning is initially generating the network database. The signal officer sets up network management and control parameters for this process.

Development of the network data base occurs twelve to eighteen months before unit deployment. The initial data base information can only change through a lengthy and costly process. The corps/division G3 and senior commanders must ensure network subscribers participate in the planning process to ensure operating parameters meet the tactical commander's C3 needs. For signal planners, mission analysis must support the unit's mission and planning guidance to determine the type of data base submissions. The number of data bases depends on the differences in force structure, missions, and geographical areas of responsibility for each contingency.(19)

The unit's commander and staff define each mission, contingency, and exercise that requires a separate data

base. When preparing the data base, the signal staff must receive several items of information including a list of all forces, an itemization of subscriber terminals which includes precedence levels, types of terminals, types of service (e.g., progressive conference and commercial network access), lists of preprogrammed conference participants, and compressed dial participants. Additional information required includes expected joint and allied interface requirements, expected geographical area of operation, authorized and restricted, and competing civilian radio frequencies.(20)

Once mission analysis is refined, the signal planners submit the information to the post deployment software support (PDSS) facility in the sustaining base. This information is vital because the SCC performs many functions using digital maps, including engineering, path profiling, and frequency management, based on such information.(21)

Short-range MSE planning also includes the more traditional aspects of operations planning such as mission analysis, network design and layout, allocating assets, and producing the operations order (OPORD). These characteristics are the main efforts of the predeployment (Phase I) activities of the MSE network. MSE deployment requires carefully coordinated procedures throughout the corps. The predeployment is broken down into the following

subphases; user requirements, interfaces, RAU/MSRT deployment, unique deployment considerations, team packets, and COMSEC.(22)

During the predeployment phase, the planners assess the tactical situation, mission, and commander's intent. This information is analyzed to allocate equipment and to support the predeployment subphases. Signal planners, based on command guidance, must determine which headquarters will receive C3 support. This also determines the method or type of signal support to satisfy (C3) requirements including connectivity with adjacent and higher units, and host nation's communications resources.

CP priorities are published in the OPORD or unit SOP. Examples are the corps main CP, the corps tactical CP, the division main CP, and the division tactical CP. Only the S3/SYSCON can direct deviating from the assigned priorities. The planner needs the initial battlefield locations of all units needing support, and if possible, any planned jump locations, and special requirements of the supported units such as commercial or tactical satellite (TACSAT) access, special telephone features, profiles, and fixed telephone directory changes.(23)

The MSE system can connect with various non-MSE hardware. Connections are called interfaces and require changes to the standard data base. Two types of interfaces are internal and external. Both interfaces have special

considerations. The network planner must determine the requirements for data base changes to the units involved in the interface. Normally, this is done at a technical conference before deployment.

Internal interfaces are simply non-MSE within our MSE networks. Examples are combat net radio interface (CNRI) and commercial access. The network planner must consider the requirements for interfaces, CNRI locations, and commercial access locations to ensure access to the extension switches for authorized users. Time is required for coordination and reconnaissance. External interfaces are links between various echelons such as echelons above corps (EAC) or allies. External interfaces also require detailed planning and coordination. Examples of these systems are EAC/adjacent corps, troposcatter or TACSAT, and NATO links.(24)

The RAU provides system access to mobile subscribers in planned corridors or areas. Mobile subscriber radio telephone (MSRT) density is greatest along main routes of march and around CP locations down to the maneuver battalion level. "There is not enough equipment to cover 100 percent of the battlefield"(25), consequently, planning must consider the tactical scheme of maneuver.

Before deployment, the S3 uses the SCC to generate the frequency plan and transmits it to one or several RAUs for distribution. The down loaded RAUs are then positioned

to serve as 'filling stations' allowing the BSOs to pick up the plans. BSOs are responsible for down loading the frequency plans to unit MSRTs.

After deployment, the RAU is turned on at the direction of the SCC/SYSCON. The RAU must be turned off if the NS or RAU's extension link fails. This allows the MSRTs affiliated off the RAU to automatically reaffiliate with the nearest operational RAU. Unique deployment considerations require significant time for technical planning.(26)

Team and equipment files, updated before creating team packets, prevent equipment/mission incompatibilities. The SCC/SYSCON generates and issues team packets before deployment. The team packets contain the information needed to open and install the different elements of the MSE network. Team packets include team orders for NCs, SENs, and RAUs assigned to the same company. Open team and open link orders provide LOS frequencies, azimuths and polarizations, locations, activation times, system profiles (or link margin), and a copy of the OPORD for each NC.(27)

MSE will not work unless the correct keys are in the correct places in all equipment. Planners must coordinate with adjacent corps and EAC for gateway keys before deployment. A sound key management plan must be understood and practiced by all operators and taught to all subscribers. Issued teams are pre-positioned COMSEC keys on the day of deployment or in the staging area. The assistant

division signal officer (ADSO) coordinates COMSEC key distribution to all division MSRT users. COMSEC accountability must be maintained for all keys distributed to each element in the network. The network managers plan and conduct orderly distribution of COMSEC keys to MSE teams.(28)

The predeployment phase ends when the OPORD is produced and distributed. The SCC's automated capabilities greatly increase the efficiency of this process. For example, "each successful LOS path profiling project that was completed during the planning phase can be printed and distributed to units responsible for installation."(29)

The S3 coordinates a schedule of events for OPORD production and distribution which will normally include a concept briefing to commanders and staff, a technical control meeting with platoon leaders, platoon sergeants, and switch supervisors covering how to perform MSE and non-MSE interfaces, and a final OPORD briefing to commanders, staff, and NC leadership. At this briefing the OPORD and the final team packets are issued to companies for distribution to teams.(30)

Network operations begin when planning is complete and the OPORD is distributed. The MSE network must be responsive to the fluid needs of the Airland Battle and the maneuver commanders. The MSE SCC's automation abilities aid

network management operations. The S3 uses the SCC as the primary network engineering tool.(31)

Installing the backbone is phase II of the MSE network deployment. It includes three subphases; NC-to-NC connectivity, duplication and bypass, and bulk transfer of COMSEC. In MSE operations, establishing and sustaining the backbone network is the critical element. The objective is for a strong NC-to-NC backbone that allows the direct bulk transfer of key sets to all NSs/LENs and RAU/MSRT frequency plans to all RAUs. Ensuring that a strong backbone is established before allowing subscriber connectivity alleviates work-arounds due to switch software, hardware, or COMSEC problems. Once deployed, node OICs follow OPORD procedures for priority of backbone LOS connectivity. All radio links may be worked at the same time; however, only one link may be engineered into the switch at a time. Duplication and bypass follow the link priority list. At this stage, node OICs inform the SCC/SYSCON of NC's movements throughout the network, or when redirection of duplication and bypass occur.(32)

The extension links are installed by priority for each NS. This is phase III of the MSE network deployment. First, RAUs to support mobile subscribers are installed. If problems are encountered, the SCC/SYSCON must be notified. These problems must be corrected before the RAUs can operate. On direction from the SCC/SYSCON, the NMF directs

the RAU operator to begin operating. The SEN teams deploy to supported Cps and provide service for static wire subscribers. They install distribution boxes (J-1077) and enforce cable/wire tagging procedures. The SEN operator initializes the SEN switchboard used in either a stand-alone or MSE network configuration and loads the COMSEC keys required for operation.(33) NC's use priority list to install SENs. NCs must coordinate priority list changes with the SCC/SYSCON.

Operational management (Phase IV) begins after establishing the network. Operational management is maintaining an effective C3 network. The SCC becomes an operations management tool or the S3 for making network changes. The information flow between all elements, units, BSOs, the ADSO, the ACSO, and the SCC/SYSCON becomes more important as the network changes and reconfiguration occurs.(34)

The S3 issues orders through the SCC to all NMFs. The SCC receives reports from the NMFs upon execution of these orders. Thus, this provides a means to update SCC files. All directives and reports are routed through the NMF to and from the S3. To ensure a successful network, the S3 influences six major areas; user access, COMSEC, subscribers, frequencies, teams and equipment readiness, and switches.(35) These six areas are discussed below.

User access can be described in terms of mobile and static subscribers. RAU coverage and frequency plans must be checked continuously to ensure mobile user access to the network. The SCC/SYSCON must be aware of all changes; including supported unit movements, that affect the network. The NC's NMF must report problems to the SCC/SYSCON. To identify problems, several management screens at the SCC aid in making network decisions when subscribers jump and equipment fails.(36)

For MSRT subscribers, the S3/SYSCON requires all NMFs to monitor RAUs. NMFs report the number of subscribers affiliated to the RAUs. When the number of MSRTs affiliated to the RAU becomes excessive, the S3 considers more RAU coverage or distributing the MSRT load to other RAUs. This requires the RAU operator to report to the NMF when all eight radios in the RAU are free. The switch then forces active MSRTs to automatically transfer affiliation to the strongest available RAU signal and places the remaining subscribers in the 'absent subscriber' mode. The SCC/SYSCON notifies the NMF to turn the RAU marker beacon back on and determine the correct number of MSRTs. However if the numbers have not changed, the SCC/SYSCON must consider the importance of subscribers and the use of modes of operation to selectively allow limited network access to priority subscribers first.(37)

The SCC/SYSCON normally controls the movement of the extension switches (small extension nodes (SEN)) which support static subscribers at the CP's. During the rapid flow of battle, the SENs may have to displace before notifying the SCC/SYSCON in order to keep pace with a supported CP. If this occurs, the BSO should coordinate with the SCC/SYSCON. Based on the BSO's coordination, the SCC can engineer systems to the extension node's proposed location.(38)

Communications security (COMSEC) plans and operations do not change when the network deploys. The SCC/SYSCON directs changes that occur once MSE assets are employed. After installing the network, subscriber key mismatch may occur. COMSEC messages are automatically reported to the SCC/SYSCON to determine if a network COMSEC problem exists.(39)

Subscriber problems are channeled from the extensions to NMFs through the subscriber cell of the SCC/SYSCON. A subscriber cell includes personnel in charge of subscriber problems. The subscriber cell handles subscriber problems and passes information down to the NMF. When the cell manages network problems, it also looks for potential problems and fine tunes the network.(40)

Subscribers with a problem contact a centralized point for help. Trouble numbers are published in the network telephone directory. The S3/SYSCON operates and

staffs a help trouble number to assist subscribers with network related problems. This number is located in the SYSCON, thus providing a network perspective for answers to problems. The BSO consolidates trouble calls in his unit and forwards them to the SYSCON.(41)

The SCC/SYSCON manages frequencies for all MSE LOS links and MSRTs/RAUs. Interference problems can occur. As the network grows, the SYSCON OIC makes the decision to manually input frequencies and can override the SCC on an exception basis. Link margins (transmission signal strength) should be monitored to manage electronic signature. RAU frequencies must be managed to ensure that MSRT users can reaffiliate in the network during frequency plan changes.(42)

Teams and equipment files are maintained by the SCC. The files need to be updated before and during each operation. This ensures the SCC has the most current information available. Before an operation, while in garrison, the S3 can use operational readiness report (ORR) to update the SCC files. Once deployed, the node OIC must feed this information to the SCC by report messages.(43)

The SYSCON also uses the switches as tools to manage the network. Switch subscriber management features provide the S3 operational management information. These features include the database, profiles, traffic load control (TLC), and zone restrictions.

Database changes for MSE links are the node OIC/NCOIC responsibility. SCC/SYSCON provides assistance for non-MSE links. If any problems are encountered, the SCC/SYSCON does problem resolution. Subscriber profile assignments can be temporarily changed by switch operators with approval from SCC/SYSCON. Traffic metering reports provide the node OIC a detailed look of a particular switch's performance. These reports include-- switch traffic report, precedence reports, and bit error rate report. With this information, the SCC/SYSCON can determine network performance.

Traffic load control (TLC) can be used to limit subscriber access at each switch during periods of low call completion rates, bad or busy trunks, or network/switch congestion. In restricted TLC levels, subscribers may receive calls, but not dial out. Zone restriction lists either allow a subscriber access anywhere in the network or restricts a subscriber's access to certain areas. The restrictive list, for example would restrict a routine user from calling outside the corps network. Changes to this list are made at the SCC and sent by technical message to the NS/LENS.(44)

Network maintenance is imperative to MSE. The signal battalion's ability to perform up to direct support (DS) maintenance on its mission peculiar equipment is vital to successful battlefield signal support. Network

maintenance generally consists of operator troubleshooting, fault isolation, and system restoration by replacing defective items from on-board spares and the unit's repair parts stockage. Equipment status is reported to the parent NMF. It then becomes the node manager's responsibility to report equipment failures to the SCC via the record traffic system in the NMF. When faults are beyond the ability of the operator, a DS maintenance team is sent forward to repair the failed system on-site. Defective equipment and components are evacuated to the battalion electronic maintenance facility for repair. If repairs cannot be performed at the battalion DS maintenance facility, the equipment is evacuated to higher echelons of maintenance through normal logistics channels.(45)

The battlefield maintenance system (BMS) is an organizational force modernization system which will change current doctrinal network maintenance plans. The development of new logistical support plans under BMS doctrine will be a challenge for the signal officer. This challenge is beyond the stated scope of this study; nonetheless, another challenge worthy of noting.

In this section, current operations of the divisional Signal battalion operations section has been described in terms of the employment and operations of the MSE communications system. MSE is described as a corps-wide, automation-based distributed network managed and

controlled centrally from the corps SCC. Consistent with corps support doctrine, the corps Signal brigade S3/SYSCON serves as the network manager, and has significantly increased manning to support such duties. The four deployment phases for MSE are described to illustrate the significant influence of the MSE network manager in providing sound C3 support to the overall tactical scheme of maneuver.

In a stand-alone division, the divisional Signal battalion operations section assumes the equivalent responsibilities for the management of the divisional C3 network. Although the fielding of MSE has provided the technology to simplify the Signal S3's job (while simultaneously enhancing divisional C3 capabilities), the divisional Signal battalion S3 has less people authorized to support his mission. Vis-a-vis the proverbial case of 'do more with less', and the exception case of automation requiring less manpower.

This provides an adequate explanation of current Signal battalion operations. An examination of the impacts of C3 force modernization (new system fielding) follows.

MATERIEL FORCE INTEGRATION PRODUCTS.

DISCUSSION OF MANEUVER CONTROL SYSTEM.

The Maneuver Control System (MCS) is a corps-wide decision support system designed to meet the maneuver C2 needs of the tactical commander and his staff. MCS provides

automated assistance to commanders and staffs to facilitate the management of battlefield information and the execution of the commander's concept of the operation. The hardware suite consists of the military specification (MILSPEC) Tactical Computer Terminal (TCT), and the nondevelopmental items (NDI) Tactical Computer Processor (TCP) and Analyst Console (AC). The software suite includes a distributed database that provides accurate and timely text and graphics information and operational tools to support the commander's decision making process. All hardware devices communicate over standard tactical communications networks and between NDI devices over a local area network (LAN). MCS will be fielded at corps, division, brigade and battalion levels.(46)

The MCS is designed to receive, store, and integrate information from subordinate maneuver elements with that from higher headquarters and the other C2 systems of the ATCCS. MCS analyzes and displays that information to assist the commander and staff in the decision process, and provide a means for the dissemination of critical information, command guidance, plans, and orders for combat operations to allow the force to function more effectively and quickly than the enemy.

MCS in not intended to ch-nge the definition of C2. Instead it is provided for the staff as a tool to replace the manual processes of C2 based on voice communication and

techniques based on grease pencils and acetate overlays. It provides a means to make information more current and available to other levels of command so each can see the same big picture of the battlefield.

The family of MCS will be employed in both heavy and light corps; armored, infantry, light infantry, mechanized, motorized, air assault, and airborne divisions; separate heavy, light, and theater defense brigades; and armored cavalry regiments. MCS is designed to support dispersed CP configurations and continuous operations in the tactical and main CPs while they relocate.

MCS will be located at corps and division main, tactical, and rear CPs and brigade/regiment level main and tactical CPs. The family of MCS for the Maneuver Functional Area (MFA) includes Armor, Infantry, Aviation, Signal, Engineer, Military Police, and Chemical units. MCS terminals will also be located at combat and combat support battalion main command post and combat trains within the MFA, command post of MFA, and headquarters of Engineer and Chemical platoons.(47) The majority of Army units will be fielded by 1992.

MCS should support mobile or frequently displacing command posts by functioning in moving vehicles and aircraft commonly utilized as corps, division, brigade, battalion, company, and platoon command nodes. This ability to operate on the move is designed to include as a minimum, the

capability to receive or transmit graphics and text formatted information.

MCS supports continuity of operations through the distributed networking of critical information to multiple locations. The intent of this MCS architecture is to permit the force level commander to command from any of his echelon's command posts (tactical, main, and rear), or from designated operational facilities of the subordinate functional control nodes.(48) For example, within the division, the division commander could influence the battle from either of the division's CPs (TAC, TOC, Rear) or from any maneuver brigade's TAC or main cp. Conceptually it follows then, that MCS encompasses a force level control (FLC) system (or function), a MFA system (or function), and a subordinate MFA system (or function).

MCS will be the information system for the force level commander and his staff. It will provide automated C2 support to enhance the quality and shorten the duration of the decision-making cycle. MCS will reduce data acquisition, retrieval, preparation, and dissemination time by providing an automation assisted over-the-air capability. It provides decision support graphics to aid in developing decisions concerning combat power employment and sustainment, coordination among Maneuver BFA subsystems, and responding to the critical information requirements of the commander.(49) MCS will provide this capability through

a network of computers linked together by local area networks (LANs) within CPs and by the wide area network (WAN) between CPs.

MCS software and hardware designs were structured into block developments called segment or versions. Each evolutionary version of software, theoretically and programmatically, builds an previously existing capabilities and lessons derived from the field to provide new and improved capabilities.

Currently fielded software is version 10.3. Version 10.3 provides decision graphics, a basic circuit-switched MSE and SINCGARS WAN communications and LAN interphase and a commercial integrated business application software package.

Version 11 software will be fielded in about 1993. Version 11 software will incorporate significant improvements, based on feedback from the field, in usability and capabilities of MCS. New capabilities will include an initial FLCS, a standard messaging set, electronic maps, EPLRS and packet-switched MSE WAN communications interface. New application software includes a terrain analysis program and an NBC information program. Subsequent software versions of MCS will provide FLCS enhancements, integrate MFA subsystems automatic EPLRS-based position-location information and a course of action development and analysis capability.(50)

The family of MCS will be operated by the personnel currently performing manual command and control functions. No additional personnel are authorized to operate, maintain or support the family of MCS equipment. MCS software requirements were for design to be sufficiently user friendly that operators need only short training period and minimal sustainment training.(51)

Initial training for MCS managers, master operators, staff users, information system managers, and commanders is conducted normally on a one time basis in units by New Equipment Training Teams (NETT).

Training for maneuver commanders and their staffs on employment and techniques associated with the family of MCS is conducted normally on a one-time basis by Training and Doctrine Command (TRADOC) Doctrine and Tactics Training (DTT) teams.

Institutional training will occur in many institutions. Familiarization on the use and employment of MCS and/or branch applicable portions of the family of MCS is included in basic and advanced noncommissioned officer and officer courses, and at the Combined Arms and Service Staff School (CAS3). Functional operator training is included in the Sergeant Major Academy Battle Staff Course and is offered as an elective course at the Command and General Staff College. U.S. Army Signal School has

developed a program to train MCS master operators at its Computer Science School.

The mechanism for operational field sustainment training is provided by functional and force level embedded training for staff users, master operators, and terminal operators. Training is tailored and embedded in each software application package provided for MCS.(52)

ANALYSIS OF THE MANEUVER CONTROL SYSTEM.

MCS has recently been fielded to the majority of the Army. One notable exception being light divisions, based on size and transportability limitations. The significance is that the impacts of MCS force modernization take on the flavor of lessons learned, rather than insightful unforeseen impacts.

Within the Signal battalion, three MCS terminals are provided. The S3 receives a TCP and the S2 and S4 each receive an AC. No additional personnel are authorized to operate and support MCS, hence there are theoretically no personnel impacts. Response from units in the field currently using MCS mandates the need for additional operators, maintainers and repair ports. Nonetheless, the only action forth coming is a change to the MTOE to identify personnel authorizations which should have MCS operator skills. Such authorization will include an MCS operator additional skill identifier (ASI).

With the TCP, the S3 section receives two DSVTs and a secure telephone unit (STU) III telephone instruments. A LAN cable is provided with the AC's to locally network the MCS. Additionally, in the MCS objective configuration, an EPLRs radio, several electronic map computer tapes, and a programmable communications interface unit (PCIU) are provided. There are no additional generators nor vehicles provided with the system.

The equipment impacts of MCS are minimal. Response from the field indicates that the MCS-to-DSVT interface is difficult to implement. The equipment is bulky, suffers high failure rates and stresses a less-than-responsive maintenance system. The use of new hardware and software, extra MSE terminal instruments and a LAN are the equipment impacts of MCS force modernization. However, this equipment impact is considered minimal because to the S3 section personnel, only the MCS software will not be unfamiliar.

Procedural impacts are best described in terms of implementing responsibilities for ATCCS management. The S3 is the overall ATCCS WAN manager for the entire divisional network. Additionally, the S3 is ultimately responsible for ATCCS operations within the Signal battalion. The operations section staff will execute these internal Signal battalion ATCCS management responsibilities. Applying the ATCCS management concept, as described in chapter 2, on the

operations section reveals procedural (read how-to-do-business) impacts of MCS force modernization.

The systems integration officer (SIO) is responsible to the S3 as the MCS FLC manager within the battalion staff based on his duties as automated data processing (ADP) manager and BAS/WAN integrator. The responsibility to the MCS network includes ensuring inputs to the Signal MFA database of MCS is current and available for maneuver operations planning. As the MCS FLC manager, the SIO will also be responsible for developing the garrison SOP for MCS within Signal battalion. This SOP will comply with the corps and division garrison SOPs, and should be coordinated with the A/S3 (training officer) based on training implications.

The Operations NCO serves as the MCS Master Operator for the operations staff. By SOP, the Master Operators assumes the duty of LAN manager. Within the Signal battalion , the MCS LAN ensures connectivity between the TCP an AC's. In this capacity, the Operations NCO facilitates BFA/C2 technical support from the SIO and the tactical automation technician warrant officer to the MCS Operators. Finally, assuming that the two E6 SCC operators are fully employed 24 hours a day, the E7 MSE network controller, the E7 MSE SCC supervisor, and the E3 driver are available to assume the additional duty of MCS operators. Significantly, the MCS terminals are in the CP operations van, not in the

SCC shelters, where the network controller and the SCC supervisor are normally working.

Based on this analysis, the procedural impacts of MCS force modernization can be simply stated as implementing ATCCS management. Simply stated, MCS will add to the list of current MSE responsibilities. Additionally, development of a garrison MCS SOP is also considered a procedural impact.

Training impacts of MCS, and the ATCCS in general, are significant. Training challenges may be assessed in terms of the three doctrinal categories of institutional training, unit training, and self training. Institutional training for MCS is widespread. It forms the foundation of MCS knowledge that determines what the Signal battalion S3 must do for unit training. Likewise, the S3 sets the foundation for self development training for individual MCS users.

Institutional training includes a familiarization course, a staff user course for officers and for noncommissioned officers and master operator courses. The Information System Manager course, and the MCS manager course are also part of the MCS institutional training base. The fundamentals of each of these courses are provided to units upon MCS fielding by new equipment training teams in approximately 200 hours of instruction to form the foundations for unit training.

Within the signal battalion operations section, the responsibility for unit sustainment training belongs jointly to the SIO and the Operations NCO. Recall that these staff members serves as the MCS manager and the master operator, respectively. In this capacity, in coordination with the A/S3 (training officer), the team develops and executes the MCS unit sustainment program.

The operations NCO is responsible for training MCS operators. The operations NCO, therefore, must ensure adequate initial operator training and follow up to maintain operator proficiency. Normal personnel rotations dictate a constant turbulence of trained MCS operators. As personnel turnover occurs, the operations NCO trains new operators, staff and commanders.

The SIO, in the capacity of the MCS manager, assists in this effort. The SIO is responsible for developing and implementing a garrison SOP for MCS which capitalizes on MCS utilities for the signal battalion. The use of the garrison MCS network provides a mechanism for daily use and facilitates sustainment training for the unit. Staff and commanders sustainment training are included in this sustainment training.

The assistant S3 (A/S3) is the unit training officer and therefore overall responsible to the S3 for the execution and effectiveness of the MCS unit training program. All these MCS functions are assumed as additional

duties. The A/S3 ensures that MCS sustainment training complements the primary duty training of the unit and its personnel. MCS operations must be balanced with the primary duties of MSE operations.

The S3 faces many challenges based on MCS force modernization. With no new personnel authorizations, the S3 must ensure MCS is manned, operated and maintained. Although equipment impacts are minimal, the S3 must ensure that operators, staff and commanders receive adequate training on new software. The integration of MCS operations must be balanced with the current duties for operations of MSE.

The S3 supervises the development and implementation of a garrison SOP for the use of MCS that provides for capitalizing on MCS functionality, supports sustainment training, and facilitates tactical operations. The S3 will face a personnel management challenge to implement ATCCS management into the division Signal battalion. Figure 6 summarizes the challenges to the signal battalion S3. These challenges are similar to those faced across the division based on MCS force modernization.

DISCUSSION OF THE JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM (JTIDS) . JTIDS is a secure, jam-resistant, data distribution system. The JTIDS Class 2M radio set for computer communications is one element of the Army Data Distribution System (ADDS). It provides a

C3 FUNCTIONAL AREAS

FORCE INTEGRATION PROGRAMS	PERSONNEL IMPACTS	EQUIPMENT IMPACTS	PROCEDURES IMPACTS	TRAINING IMPACTS	LEADERSHIP IMPACTS
MANUEVER CONTROL SYSTEM (MCS)	NO ADDITIONAL PERSONNEL	TCP TWO DSVT LAN CABLE MAP TAPES PCIU	IMPLEMENT ATCCS MGMT DEVELOP GARRISON SOP	UNIT TRNG FOR CDR, STAFF USERS, AND OPRS	PERSONNEL MGMT, FLC MGMT FOR SIGNAL MFA
JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM (JTIDS)					
INTEGRATED SYSTEM CONTROL (ISYSCON)					

Figure 6: MCS CHALLENGES TO THE S3

non-nodal, line-of-sight, ultra-high frequency (UHF) based radio network for digital communications. The JTIDS component of the ADDS supports Air Defense Artillery (ADA) battlefield automated systems. In the ATCCS, this is the Forward Area Air Defense (FAADS) C2 system.

JTIDS supports users which require joint service interoperability using joint message formats, high digital data rates, and high anti-jam capabilities. The system also provides position location reporting and cooperative identification to battlefield users. With in the division Class 2M radio sets will be installed, operated, and maintained by the ADA in FAAD C2 host systems and by Signal operators for Net Management Centrals (network control shelters) levels.

The JTIDS network will be collectively planned, installed, and managed by the Air Defense Artillery and Signal Corps. Execution of any JTIDS network is a shared responsibility.(53)

Army JTIDS consists of the basic JTIDS Class 2M radio set, the Net Management Central (V)1 (NMC (V)1), also known as the Net Control Station for JTIDS Dedicated JTIDS (NCSJ), and the Net Management Central (V)2 (NMC (V)2), also known as the Dedicated JTIDS Relay Unit (DJRU). In this thesis, the terms NCSJ and DJRU will be used for clarity, but both are considered network management facilities. The Class 2M radio set is integrated into the C2 user's host

system in conjunction with battlefield automated systems communications. The NCSJ and DJRU establish the backbone of the system and create a data communications network for ground-to-ground information distribution.

The Class 2M radio set is a user owned and operated data radio terminal integrated with the host system. The user's host system is an Army Tactical Command and Control System (ATCCS) Transportable Computer Unit (TCU) integrated into ADA shelters at designated FAAD C2 ground based sensors and C2 nodes.(54)

The NCSJ is a shelter configured JTIDS Class 2M radio set that provides ground to ground relay connectivity. It performs network management functions for community of users of up to 32 network participants. These functions include: off-line functions such as network initialization file planning, crypto key loading and generation and file management; and on-line functions such as monitoring network status, making initialization data changes, and over-the-air rekeying (OTAR) network terminals. A crypto key generation device must be installed within the NCSJ in order to utilize its crypto network management functions. The NCSJ also meets the Joint service interoperability requirement and provides position data for other JTIDS equipped units.(55)

Three NCSJ and five DJRU's will be fielded to the divisional Signal battalion to the JTIDS network. Together with eight FAAD C2 shelters, the JTIDS network in the

division will have sixteen radios. This is a small C3 network relative to the number of radios or users in current MSE or SINCGARS networks in the division.

The authorized crew for each NCSJ/DJRU consist of three soldiers in military occupational specialty (MOS) 31C--single channel radio operators. The three soldier team and unit level maintainers consist of an E5/Sergeant as team chief and two E4/Specialist as operators and unit level maintainers. Organizational, the eight NCSJ/DJRU teams are split into two sections. The section chief of each is an E6/Staff Sergeant. All together, they form a JTIDS platoon in the Signal battalion. For C2 of the platoon, authorizations include a Lieutenant as platoon leader and an E7/Sergeant First Class platoon sergeant.(56)

The DJRU provides an interface to the NCSJ for terminals acting as relays in the network, displays current network connectivity status and status of the local Class 2M radio, and performs link margin verification (LMV). The DJRU performs all the functions associated with the NCSJ, with the exception of OTAR. An DJRU may function as an NCSJ with the addition of a crypto key generation device.

The Network Management Computer Program (NMCP) is a menu driven software application, written in the Ada computer language, used to operate the NCSJ and DJRU. The computer program is the same for each TCU. The functions which the computer program performs depends on the mode of

operation (relay only or network controller) selected by the operator during system start up. The operator must tell the TCU (enter keystrokes into the computer) whether it is an NCSJ or DJRU Initialization of the FAAD C2 application software is similar to that used by the NCSJ and DJRU host systems. The ADA host computer runs ADA (FAAD C2) specific application software which meets ADA operational needs. This differs from the Network Management Centrals which run network management software. Each of these software applications are transparent to the Soldier operating the system.(57)

Bandwidth Requirements (timeslot allocations) are based on JTIDS participant needlines (a needline can be seen as a communications channel or bandwidth). The NCSJ must be told by the SYSCON what block of the bandwidth is to be used for joint operations. This must be done prior to system initialization with the NCSJ's rapid load initialization file.(58)

The JTIDS fielding concept is user owned, operated, and maintained. Signal units (particularly SYSCONS) are responsible for planning and directing the network within the Corps boundaries. Signal units will deploy NCSJs and DJRUs as required. No personnel additions are allowed for automated system users (the BFAs). Signal personnel additions are allowed for signal units. The Signal battalion S3, functioning in his system control (SYSCON)

role will perform network functions. Other system connectivity missions will be installed by NCSJ/DJRUs as required.(59)

The Army JTIDS network is employed to support ADA command and control. Two types of operations performed by Air Defense forces, from a C3 perspective, are Force Operations (FO) and Engagement Operations (EO). FO are those actions taken to plan, coordinate, prepare for, and sustain the total AD mission area effort, similar to the needs of any maneuver, combat support, or combat service support unit on the battlefield. Requirements for information updates (bandwidth requirements) are normally measured in minutes permitting use of the Area Common User System (ACUS) and Combat Net Radio (CNR). EO are those actions required to execute the air battle. AD EO consists of seven sub-functions: track air vehicles; integrate ID; correlate tracks; filter geographically; display data; execute airspace control; and distribute fires. The quantity of data to be distributed and the required speed of service is much greater in EO than in FO. EO functions are therefore processed through decentralized control. Information must be transferred directly from the source (sensor) to the user (fire unit) regardless of echelon. EO data response times are therefore measured in seconds and require a data distribution system dedicated to EO

functions. JTIDS meets this requirement for the ADA community.

Six FAAD C2 ground based sensors/C2 nodes are deployed with embedded Class 2M radio sets and other C3 equipment in support of the division air battle. The signal battalion's three NCSJs and five DJRUs are employed to provide network connectivity and management. These systems are essential to connectivity of the net due to line-of-sight communication limitations. One primary NCSJ is designated of the three deployed. The remaining two NCSJs will function as secondary net control stations for continuity of network management operations during displacements and in case of failures. The primary NCSJ generates the network initialization data based on information from the Integrated System Control (ISYSCON). In the event that the ISYSCON is not fielded prior to JTIDS the NCSJ and DJRU computers can provide the automation assistance required by the S3.(60)

The NCSJ initializes all terminals within the net, manages all network cryptovariables, and performs net and technical control functions. In addition, each NCSJ performs a relay function. JTIDS Class 2M radios link the Air Battle Management Operations Center (ABMOC) (or AD Bn TOC) and the Army Airspace Command and Control (A2C2) element of the Division G-3 into the network. Data generated by the ground based sensors is distributed

throughout the network. The air picture and targeting information is derived from the AWACS air picture correlated with or independent of FAAD C2 ground based sensors/C2 nodes processors. Friendly information is incorporated into the air picture by receipt of automatically transmitted Precise Position Location Identification (PPLI) messages from all JTIDS users. The FAAD C2 processor located at the ABMOC correlates the external air tracks with internal tracks to produce a correlated air picture. Fire missions and AD control measures are passed to the AD fire units.(61)

The Army's network design and management of JTIDS focuses on the NCSJ. A typical step by step flow of events for complete JTIDS network operations is as follows.

> Step 1. The NCSJ is used off line to perform network design based on directives from ISYSCON.
> Step 2. The NCSJ is used to perform crypto planning, key generation, and initial physical key distribution.
> Step 3. Siting tools are used to determine initial deployment (or coordinated moves during operations) of the Division Signal Battalion's JTIDS terminals.
> Step 4. All systems are deployed, installed and achieve synchronization.
> Step 5. The NCSJ assumes control and evaluates network connectivity.
> Step 6. Corrections to siting are made (if required) from an evaluation of link margin verification results received by the NCSJ operator. These results are reported to the ISYSCON, where courses of action are determined.
> Step 7. The NCSJ implements any required changes to network design at the direction of the ISYSCON.
> Step 8. Over-the-air-rekey is automatically performed by the NCSJ after each crypto period crossing.
> Step 9. The NCSJ continues to monitor and maintain the network.

Step 10. In the event of a displacement, the operator of the NCSJ and DJRU return to step three.(62)

ANALYSIS OF THE JTIDS. JTIDS has been fielded to Air Force and Navy users, and has been tested in quasi-operational field environments during its early stages of development. Full scale production configurations of JTIDS, functioning as a network in the ATCCS WAN, has not occurred. The significance is that the impacts of JTIDS force modernization are insightful, rather than observations.

The impacts of JTIDS force modernization are of a somewhat different perspective than that of MCS previously discussed. Although for the purpose of this thesis, the focus is the effects on the Signal battalion operations section, some relative comparisons are noteworthy of introduction.

MCS, as previously described, much like MSE current operations, are corp-wide networks. These networks are maneuver commander's assets. Corps allocated assets, including staff assistance and technical supervision, to support the division. Resolution of MCS force modernization issues are at the discretion of the entire corp and subordinate staffs. This represented a huge resource to apply to resolution of significant issues.

When the division is deployed in a stand-alone mode, the signal battalion operations staff assumes the large majority of those tasks performed by the corps signal

brigade staff. However, the situation in the case of MCS, like that of MSE, is that the habitual use of systems under corps supervision have conditioned divisional signal battalion staffs on how to operate autonomously. Such will not be the case with JTIDS. Additionally, with MCS, the divisional signal battalion staff can simply be considered another user-- not much different than any other MFA user. Again, the situation is not the same with JTIDS, where the Signal battalion staff has a more far reaching impacts.

JTIDS may be viewed as a C3 system that only supports divisional ADA. There is no corps-wide ADA force structure and no corp-wide ADA network-- except maybe implied doctrinally. JTIDS networks are not envisioned to be employed at the corps level by the corps signal brigade-- as with MSE. Hence, it follows that the impacts of JTIDS force modernization will fall on the signal and ADA units within the division. Corps signal and ADA expertise will not be prone to consider the impacts of JTIDS because it is being fielded as a divisional system.

In general terms, JTIDS network operations are much similar to current MSE network operations. During predeployment, the JTIDS initialization files generation is a long bad time item like the MSE data base generation. Short lead time items for both include coordination of subscriber/user location and initial distribution of COMSEC keys to plan connectivity. Upon deployment, the backbone

network is installed by establishing strong internodal links between the node centers for MSE. For JTIDS, the NCSJ/DJRUs deploy into a initial 'backbone' network. For MSE the extensions are next installed to supported CPs. For JTIDS, the ADA users connecting to the backbone is equivalent to installing extensions. Finally, once deployed both networks implement minor required changes to provide continuous quality service to subscribers/users.

Both network, contribute to the execution of C2, but the impacts of the networks are much different. MSE provides the entire corps/division with a telephone network from maneuver battalion CPs to corps headquarters CPs to execute overall C2. JTIDS provides the divisional air defense unit with a computer communications network to execute air battle C2. The MSE network reacts to support battalion level CP movements within the corps/division; the JTIDS network reacts to support team level movement, within the divisional ADA battalion. Nonetheless, the impact on the signal battalion operations section is another entire network employ and manage.

The signal battalion S3 will face significant leadership impacts with JTIDS force modernization. For network management responsibilities, the operations section's workload will conceptually double because JTIDS will be a second totally separate C3 network to plan, engineer, employ, and manage.

JTIDS is a joint C3 system. The premise of receiving JTIDS is to facilitate direct joint service communications connectivity. In the divisional ADA application, the ADA battalion TOC (ABMOC) and/or the ADA LNO in the division G3 A2C2 cell will require joint connectivity. There will exist situations when the signal battalion operations section is expected to design, engineer and manage joint JTIDS networks. Such authority as a joint network manager requires front end coordination between divisional ADA users, Signal network managers and joint service users. Air Force users on the divisional network include operational level assets such as F-15 aircraft traversing the divisional airspace to conduct air interdiction and the E-3 AWACS aircraft conducting early warning surveillance. The information exchange over JTIDS is crucial to executing the air battle.

The leadership impacts of JTIDS force modernization are significant. The authoritative responsibility for joint service connectivity requirements are essential to the potential fratricide issue. The management responsibility of a newly deployed network is comparable to the operations section's current responsibilities when the division deployed autonomously.

Despite these significant leadership challenges, JTIDS will be fielded with no additional personnel authorizations for the operations section. With no

personnel authorization in the SYSCON, there are theoretically no personnel impacts of JTIDS force modernization. Instead, however, the operation staff of the divisional signal battalion will be tasked further to perform network management of the JTIDS network, above and beyond their current SYSCON duties for MSE and their MFA duties associated with ATCCS management for MCS.

The signal battalion receives three NCSJs and five DJRUs to employ a JTIDS backbone network. The operations section receives no new equipment with JTIDS fielding, per se, but, the SYSCON, until the fielding of the ISYSCON, is tasked with designing and engineering the JTIDS network with the automated tools resident in the NCSJ's net management computer program (NMCP). The equipment in the NCSJ significant in this respect includes an ATCCS CHS TCU, the CL 2M radio set, and the NMCP. This equipment is categorized as new hardware and software equipment impacts based on JTIDS force modernization.

To support JTIDS network operations, the signal battalion operations section will implement new procedures. The key aspects of JTIDS network operations which requires these new procedures is the evaluation of link margin verification (LMV) of JTIDS LOS links to correct predeployment siting considerations. This aspect of JTIDS network operations, as compared the current MSE network operations, is discussed below.

For JTIDS, network siting (path profiling) software tools in the NMCP are used to assist in planning LOS connectivity and predicting link margin for planned network links. This is step 3 of JTIDS network operations, as discussed previously. Link margin is a measure of the strength of the link, measured in decibels, above the amount required to minimally maintain radio frequency connectivity. The SYSCON must ensure that initial deployment locations of NCSJ/DJRUs allow sufficient link margin to overcome LOS restrictions and expected enemy jamming. This expected jamming is based on intelligence preparation of the battlefield.

In step six of JTIDS network operations, corrections to NCSJ/DJRU sitings are made based on an automated evaluation of link margin verification results. This is a significant step. The idea is that in step three above, network siting was based on 'predicted' link margin. In step six, once the particular NCSJ/DJRU is deployed, if the link margin 'measured' is sufficiently lower than that predicted, the SYSCON must determine a corrective action. Corrective action alternatives available to the SYSCON include increasing transmit power, changing antenna heights, adding more NCSJ/DJRU relays, and changing site location. Changing a site location is the least desirable alternative because it is the most time consuming. It is, however, more attractive than doing nothing and accepting the risk.

In this case, a sufficiently lower measured link margin is one which would make the link (and maybe the entire network) unsurvivable under enemy jamming. The risk in losing a link to jamming would be a gap in divisional air defense coverage. A worst case scenario could then yield an enemy air corridor open to the division rear area. Military intuition dictates this is undesirable.

The new procedure for JTIDS network operations is significantly different than the current procedures for MSE operations. With MSE, planning for network connectivity under enemy jamming is not a deliberate step. Instead, it is an implicit, but unstated rule of thumb employment using a "signal sense," and passive techniques such as terrain masking.

The deliberate efforts involved in implementing LMV in JTIDS network operations is categorized as a procedural challenge for the SYSCON/S3. This elaborate LMV procedure will be occurring simultaneously with current MSE network operations. Thus, while SYSCON personnel are involved in JTIDS LMV operations, they are not available for their primary responsibilities of MSE network operations. Additionally, in most deployments, to facilitate these simultaneous network operations, it is desirable to collocate the primary NCSJ near the MSE SCC. This may not, however, always be feasible based on JTIDS network connectivity requirements in support of the tactical scheme

of maneuver. When it is not feasible to physically collocate the NCSJ with the MSE SCC (and normally the signal battalion CP), the SYSCON must rely on collocating electronically. This would be accomplished by maintaining combat net radio (CNR) communications, and is therefore less reliable than physical collocation.

To facilitate JTIDS network operations, the S3 will be required to develop some undefined mechanism to relieve the demands on the signal battalion operations/SYSCON personnel. One possibility is discussed below.

Recall that although there are no additional personnel authorizations to the signal battalion operations section, there are some for the JTIDS platoon in the signal battalion. These additional personnel included the platoon leader, platoon sergeant and two section chiefs authorized for organizational C2. These soldiers are not authorized doctrinally for JTIDS network operations. However, logic dictates that these soldiers must perform network operations functions-- not simply provide leadership and administrative and logistical support to operators.

This procedure would be similar to current MSE operation. With MSE, area company nodal platoon leaders are involved with technical aspects in coordinating MSE operations with the S3, and function as node OICs when deployed. With JTIDS, the platoon leader could function, in

close coordination with the SYSCON SIO or A/S3, as the NCSJ OIC to facilitate JTIDS network operations.

Inherently, this platoon leader would be considered out of main stream signal operations because of the non-association with MSE operations. A sound leadership development program within the unit would allow for duty rotation. Four possible rotations for the JTIDS platoon leader are platoon leader in an MSE platoon, company XO, ADA battalion signal officer, or significantly, to the SIO in the signal battalion operations section.

The signal battalion operations section will be responsible for planning and executing JTIDS network operations sustainment training. Inherently, this responsibility also will require SYSCON personnel, in cooperation with the ADA battalion signal officer (BSO), to coordinate JTIDS training for the ADA operators. The assistant S3, based on his duties as the training officer, and possibly, the JTIDS network manager, will be responsible to the S3 in this capacity.

JTIDS force modernization will provide significant challenges to the signal battalion S3 and the operations staff. With no additional personnel authorizations to the operations staff, the S3 must ensure coordinated training between ADA users and signal user. This training will focus on using new hardware and software to perform network operations for a totally new and separate data network.

Procedures for JTIDS network operations will be conceptually similar to current MSE network operation for the most part. The exception being the requirement to planning network operations under enemy jamming conditions.

Lastly, in addition to the divisional network management and training responsibilities, the authority for joint service network management is considered a leadership challenge. Figure 7 summarizes these challenges to the signal battalion S3.

DISCUSSION OF THE INTEGRATED SYSTEM CONTROL (ISYSCON). The Integrated System Control will provide the capability to manage the availability of C3 in support of AirLand Operations. The current Signal battalion S3, in the role of the SYSCON, performs functions and procedures manually. With the introduction of automation provided by the Army Tactical Command and Control System (ATCCS), a manual SYSCON function will not support AirLand Battle (ALB) operations.

The Integrated System Control (ISYSCON) is an automated system designed to manage multiple communications and automation systems in real time. ISYSCON provides the necessary tools to perform the management process by automating essential functions, including: network planning and engineering, battlefield spectrum management, wide area network management, communications security management, and command and control of Signal units.

C3 FUNCTIONAL AREAS

FORCE INTEGRATION PROGRAMS	PERSONNEL IMPACTS	EQUIPMENT IMPACTS	PROCEDURES IMPACTS	TRAINING IMPACTS	LEADERSHIP IMPACTS
MANUEVER CONTROL SYSTEM (MCS)	NO ADDITIONAL PERSONNEL	TCP TWO DSVT LAN CABLE MAP TAPES PCIU	IMPLEMENT ATCCS MGMT DEVELOP GARRISON SOP	UNIT TRNG FOR CDR, STAFF USERS, AND OPRS	PERSONNEL MGMT, FLC MGMT FOR SIGNAL MFA
JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM (JTIDS)	NO ADDITIONAL PERSONNEL	NMCP JTIDS CL2M TERMINAL TCU	IMPLEMENT THREAT-BASED LMV DEVELOP USE JTIDS PLT LDR IN NETWORK OPERATIONS	COORDINATED ADA/SIGNAL OPR/NETWORK TRNG	NEW NETWORK TO MANAGE, JOINT NET MANAGER AUTHORITY
INTEGRATED SYSTEM CONTROL (ISYSCON)					

Figure 7: JTIDS CHALLENGES TO THE S3

The ISYSCON will incorporate six standard workstations into a LAN to perform communications networks command and control, distributed database management, and network engineering task processing. The ISYSCON will electronically interface to other ISYSCONs, subordinate communications control facilities, and BAS' as required to perform systems planning, control, monitoring,and gateway management between alternate, adjacent, and to strategic networks(63)

ISYSCON is employed by Signal units to manage IMA assets in support of combat forces, weapons systems, and their supporting battlefield automated systems. It will facilitate design of a communications network which optimizes placement of limited resources against subscriber requirements, considering terrain and tactical restrictions. ISYSCON will provide system engineering for both communications and non-communications electronic systems and perform data distribution system engineering for both communications and non-communications electronic systems and perform data distribution system engineering functions for the ATCCS to ensure that information flow requirements are met. It will provide the entire range of battlefield spectrum management (BSM) functions to include joint, combined, and allied operations. ISYSCON will make all frequency assignments to minimize/eliminate adverse

collateral effects of new frequency assignments on other systems.(64)

ISYSCON will be fielded to the Theater Signal Commands, tactical Signal brigades, division Signal battalions and with remote terminals to the Signal officers of maneuver brigades and major subordinate commands at each echelon.(65)

Six intelligent workstations are anticipated in ISYSCON. Two will be located inside the ISYSCON shelter. The other four workstations will be used outside the shelter, connected to the two internally mounted workstations by a local area network (LAN). Functionally, five workstations will perform communications management functions, and will be used by the Signal staff to simultaneously manage the five functional areas of ISYSCON. The sixth workstation will be used by the system operator/maintainer, to allow required database updates/system maintenance.

The ISYSCON will ensure continuity of operations (CONOPS) by: Distributing and selectively replicating, in part or in total, key databases among ISYSCONs at different workstations, locations or echelons.

Automated interfaces to ATCCS systems are required to maintain an accurate picture of the tactical situation. An automated interface to ATCCS is required in order to exchange command and control information and maintain ATCCS

network(s) status. Automated interfaces and Battlefield Automated Systems (BAS) are required to exchange technical information with each BAS and to provide the ATCCS system managers with the status of connectivity of each BAS to the signal-controlled Wide Area Network (WAN) as applied to that system. This interface shall be accommodated through FLCS where possible, but may be accomplished by technical means.

Automated interfaces with tech control facilities are necessary to maintain current status of communications systems, and to issue orders in a timely manner. Establishing and maintaining direct, automated interfaces and interoperability with existing Army communications technical system control facilities is key to integrated network management. This will also allow ISYSCON to use any of the available communications means as a way to receive or transmit data.(66)

Portable remote terminal devices which can perform portions of functions done at the CP configured ISYSCON are required to distribute technical and functional information between ISYSCON and signal officers assigned to non-signal units. Non-signal units requires access to each of ISYSCON's software modules. This capability will allow the Signal Officer who is not located at the Signal Unit CP access to, and limited input to, the information in each battlefield functional area. To show how the overall network relates to his/her unit, and allow the Signal

Officer to provide unit particular data to the Signal unit S3, or G6/ADSO. Although the Signal Officer will be able to read information on other units he/she may only change data on his/her own unit. Employment of the remote terminals will be left to the discretion of the Signal commander at each echelon.

Division Signal battalion possible user include the G6, maneuver brigade Signal officers, aviation brigade Signal officer, the DIVARTY Signal officer, the DISCOM Signal officer and separate battalion Signal officers (i.e., the ADA Bn).(67)

ISYSCON hardware and software will require block development, which will be executed in an evolutionary manner in three modular blocks. Each block will build on the hardware and software capabilities provided in the previous block.

The following paragraphs describe the block development of hardware and software for this program, utilizing rapid prototyping and user group feedback to insure that the software meets the users needs.(68)

Basic capabilities in Block 1 include the integration of all hardware into the shelter, and software integration onto the hardware. Block 1 will be fielded to four division. The automated key management system (AKMS) will operate in a stand-alone mode. Physical and software interfaces and interoperability will be required in this

block to the MSE SCC, to the MSE packet switched network (PSN), to EPLRS and JTIDS (NCSE and NCSJ), and to the ATCCS. Contextual help screens will be included for each software module. Development will be started on other required interfaces software packages required for this block will include the following:

(a) BSM, including frequency deconfliction, cosite/off-site interference resolution, an MSRT/RAU/SINCGARS Deconfliction Module, an Emitter Database Module to assign frequencies considering the background and the intelligence/electronic warfare (IEW) requirements.

(b) Network Planning & Engineering, including basic Communications System Siting Tools and an initial Communications Gateway Planning Module for both Army-unique and Joint operations.

(c) WAN Management, including an initial MSE Packet Switching Management Module, an initial JTIDS Management Module, and an ATCCS Status Reporting Module. This includes the capability to maintain the status of the host computers which comprise the ATCCS nodes. Initial status reporting for ATCCS hosts will be accomplished by interfacing with the NCS-E or NCS-J for ATCCS hosts directly connected to JTIDS, and MSE packet-or circuit-switched networks.

(d) An initial Signal Command and Control Module.

(e) ISYSCON executive, including initial External Software Interface and System Administrator Modules, which interface with available communications systems.(69)

Block 2 will be fielded to remaining active duty units. Refinement of interfaces to all software modules will be refined/improved, with major improvements done in training modes of operation, and frequency deconfliction. Block 2 will provide integration of AKMS software into ISYSCON. Development of interfaces to ATCCS for WAN Management purposes will completed. Development will continue in the areas of artificial intelligence (AI) (rules/knowledge based) planning modules. A hardware upgrade will be made, if required.(70)

Block 3 Improvements will be fielded to all Reserve/National Guard units. Significant software improvements include: Complete integration of AKMS software, finalized signal command and control modules, electromagnetic compatibility modeling module. Refined physical and software interfaces with all technical control facilities, completed network planing modules (AI based), and completed embedded training modules will be completed. Major software (and hardware if required) upgrades will be make to all units.(71)

Personnel will be assigned to the ISYSCON as the primary unit level operator-maintainers of the system. They will manage all external technical and communications

interfaces, as well as perform database updates and organizational maintenance. Staff users will perform communications systems management tasks and some operator tasks. Signal battalion staff users will be officers, warrant officers and NCOs assigned to the operations section. The staff users of portable remote terminals at the ADSO and in non-signal units may include those listed above. Total number of authorized within the divisional Signal battalion will not increase.(72)

Each ISYSCON will have several enlisted soldiers assigned to each assemblage (one per workstation). Additionally, each ISYSCON will have two soldiers, as the computer system maintainers. Portable remote terminals deployed to non-signal units will be operated and organizationally maintained by assigned signal officers and senior noncommissioned officers.(73)

Eventually manual tasks must be eliminated or simplified. The length of courses will not be increased. Sustainment training requirements in units will not be increased, although some operator training will be conducted in the unit.

Operator training will include the overall operation of the equipment, unit maintenance, and preventive maintenance checks and services (PMCS). Supervisory training will be accomplished at the Signal Center.

Initial training for operator/maintainers, staff users and commanders will be conducted in units by New Equipment Training. Institutional training on the use and employment of ISYSCON will be integrated into programs of instruction at selected schools and centers.

Sustainment training in units will be provided by embedding, to the maximum extent technically feasible, training. Training will be tailored and embedded in each application package. Minimum embedded training for operators and staff users will consist of contextual help menus, screens and a scenario-driven, training modes.(74)

ANALYSIS OF THE ISYSCON. ISYSCON has not been developed. Some of ISYSCON's software packages are currently available and only require modification and integration into a single software system. The hardware configurations for ISYSCON will be driven by software processing requirements and bounded by the general Army requirements of common hardware and software. The significance is that the impacts of ISYSCON are entirely predictive.

In order to lay the foundation for the analysis of impacts resulting from ISYSCON force modernization, it is relevant to discuss the C3 environment that will exist when ISYSCON is fielded. As already discussed previously, MCS, including Version 11 software will have been fielded to provide an initial FLCS capability between the five BFAs of

the ATCCS. Beyond MCS, the other four BFA C2 systems of the ATCCS will be fielded. JTIDS will be fielded in support of the ADA C2 system, as will another separate communications system-- EPLRS. Additionally, a major improvement to the MSE system, the MSE Packet Network (MPN), will be fielded as part of the theater-wide tactical packet network (TPN). The MPN adds a dedicated packet switched data communications capability to the original circuit switched MSE network. The MPN will significantly enhance C3 support to corps/division-wide users. It provides the communication means for the realtime exchange of force level control information the commander and staffs used to conduct tactical operations. Also, the MPN provides the means to network ISYSCONs.

The ISYSCON provides an automated capability to manage C3 systems in support of tactical operations. It will assist in the management of multiple communications systems and BFA C2 systems, in real time, by centralizing the automation of individual network planning and engineering for WAN management, including COMSEC management, and C2 of signal units and elements, including those at the division staff and the BSOs in nonsignal units, to enhance quality and responsiveness of signal support throughout the battle.

ISYSCON is the first and only of the three systems analyzed in this research effort which provides additional

personnel authorizations to the signal battalions operations section. Six enlisted operators, one per workstation, and two enlisted maintainers are authorized for the ISYSCON. Overall, by TOE, the signal battalion experiences no gain in personnel, though, because these personnel are reorganized from the division signal office to the signal battalion operations section. The bottomline effect is to collocate operators with their equipment since the same authorization were allocated to support the SYSCON functions of network engineering, frequency management and COMSEC management.

With the S3 section, these additional authorizations is categorized as a personnel impact based on ISYSCON force modernization. The impact will be beneficial in this case, however, as opposed to no increased authorizations in the case of MCS or JTIDS. This addition of dedicated operator and maintainers serves to reduce the legwork required for current operations section personnel leadership by substituting electronic connectivity to other ATCCS networks for potential physical collocation, as previously discussed. This means that the senior personnel of the operations section will primarily be at one location to perform their multiple tasks.

These new operators and maintainers will be subject to new hardware and software equipment impacts. New equipment provided by the fielding of ISYSCON includes the six workstations and the LAN provides that

interconnectivity. The equipment is proposed to be housed in a two truck, two trailer assemblage deployable into a standard integrated command post shelter (SICPS) configuration. Mobility and transportability issues could be significant, but are beyond the scope of this effort. However, the six workstation, with their new soldier-machine interface software, and the LAN are categorized as equipment impacts for the signal battalion operations section.

Procedurally, the impacts of ISYSCON can be described in terms of both current operations and procedural changes caused by MCS and JTIDS force modernization. To support current MSE operations, the SYSCON needed to understand the tactical scheme of maneuver at divisional battalion level. By understanding the flow of the battle, the SYSCON deploys MSE assets to connect major subordinate CPs to the corps/division headquarters CP to allow the commander a means to C2 forces.

The addition of the MCS allows commanders and staff a means to facilitate the exchange and sharing of information, at the maneuver functional area level. The status of forces and equipment on hand to conduct tactical operations is the focus of such information. As such, the signal battalion operations section functions with MCS focus on assessing current and future tactical operation requirements, and reporting the status of the signal MFA to support current and future operations. This change

recognizes the idea that C3 affects maneuver; that the commander must 'fight' C3 assets much like logistics, fire support, and the maneuver element itself.

Fielding the JTIDS system in support of air defense focuses the SYSCON perspective. Beyond the requirement influence the concept of the tactical operation at the major subordinate CP level, the SYSCON must know how the elements within the divisional air defense battalion will deploy to support the air battle in the tactical scheme of maneuver in order to provide JTIDS support to the divisional ADA battalion. This represents a large increase in coordination and responsibility for the Signal battalion S3/SYSCON. Though the impacts of the other four BFA C2 systems of the ATCCS, and their supporting communications networks are beyond the scope of this thesis, their impacts can be extrapolated for the above discussions of MCS and JTIDS. The manual execution of SYSCON functions could not have provided responsive C3 support to the divisional C2 process.

The ISYSCON makes it possible for the SYSCON to provide proactive and responsive signal MFA support to all elements of the ATCCS. It will make the S3's job easier. It facilitates the entire signal operations process.

During predeployment activities, network design and COMSEC management SYSCON functions can be centralized at the ISYSCON, as opposed to conducted separately at the MSE SCC, the JTIDS NCSJ, and other communications control facilities.

During initial deployments, the simultaneous buildup of C3 networks can be managed from a centralized location. These activities include establishing backbone networks, extensions and subscriber/user connectivity. This could eliminate the requirements for collocating the MSE SCC, the JTIDS NCSJ, and the signal battalion TOC which houses the MCS devices. Once the division is fully deployed and networks are operative, the ISYSCON will serve as the only source of information on location and status of the friendly force because it is the only facility which will provide connectivity information from the individual BFA C2 user up to the corps headquarters CPs. Conceptually, new procedures for the operations section will be required to implement WAN management a transition from a tailgate-to-tailgate, legwork-intensive manual philosophy to a workstation-to-workstation, swivel chair-based automated philosophy.

The development and implementation of such new procedures are categorized as a procedural impart of ISYSCON force modernization. Significantly however, in the C3 environment characterized by multiple communications network supporting several C2 systems which automate the C2 processes to provide force and equipment status to the commander. The ISYSCON will provide the means to synchronize operations throughout the depth of the battlefield.

The training challenges brought about from ISYSCON force modernization are controversial speculate. Two factors determine the training implications for ISYSCON; the level of institutional training and the quality of embedded training software. If the institutional ISYSCON training is provided to commanders, staff and BFA C2 staff users and operators, the burden of the signal operations staff can focus on employment characteristics and operator/maintenance functions. Based on the broad application of ISYSCON functions to C3, such can be assumed to be the case. Embedded software for each ISYSCON application package is proposed as the basis for unit sustainment training of the signal battalion operations section personnel. Historically, the potential of embedded training software has provided a tool for training operator/maintainer task training. But the potential for ISYSCON embedded training to provide adequate familiarity into how individual ISYSCON operator tasks may affect the entire divisional C3 framework are considered remote.

The training impacts for ISYSCON force modernization center on staff users-- the S3, A/S3, SIO and non-signal unit BSOs, and their ability to educate commanders and operators on the linkages between ISYSCON operations and other C3 assets. Simply stated, these impacts are referred to as collateral C3 effects.

There will be several leadership implications for the S3 and his staff in the divisional signal battalion. The addition of personnel implies new supervisory responsibilities, specifically for the operations NCO, in role of enlisted supervisor. The SIO and the tactical automation network technician, in their role of BAS/WAN integrators, are directly responsible to the S3 for the effective use of the ISYSCON within the division. This authoritative responsibility for WAN technical control of the ATCCS distributed network is unprecedented. The S3, as the WAN manager, will have more personnel and powerful facilities available to execute such responsibilities.

ISYSCON force modernization provides unique leadership challenges to the signal battalion and the operations staff. New operators, maintainers, and facilities authorized for ISYSCON allow a welcomed tradeoff between the manual legwork-intensive tailgate management philosophy and the swivel chair-based automated philosophy with additional supervisory responsibility. Simplified procedures implemented to use the ISYSCON for the signal battalion to C2 of signal operation will be required. Moreover, corps/division-wide procedures will allow the ISYSCON to provide the means to synchronize the force deep, close and rear battles. Implementation of such procedures will require the understanding of collateral C3 effects. Training challenges for these procedures will extend from

C3 FUNCTIONAL AREAS

FORCE INTEGRATION PROGRAMS	PERSONNEL IMPACTS	EQUIPMENT IMPACTS	PROCEDURES IMPACTS	TRAINING IMPACTS	LEADERSHIP IMPACTS
MANUEVER CONTROL SYSTEM (MCS)	NO ADDITIONAL PERSONNEL	TCP TWO DSVT LAN CABLE MAP TAPES PCIU	IMPLEMENT ATCCS MGMT DEVELOP GARRISON SOP	UNIT TRNG FOR CDR, STAFF USERS, AND OPRS	PERSONNEL MGMT, FLC MGMT FOR SIGNAL MFA
JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM (JTIDS)	NO ADDITIONAL PERSONNEL	NMCP JTIDS CL2M TERMINAL TCU	IMPLEMENT THREAT-BASED LMV DEVELOP USE JTIDS PLT LDR IN NETWORK OPERATIONS	COORDINATED ADA/SIGNAL OPR/NETWORK TRNG	NEW NETWORK TO MANAGE, JOINT NET MANAGER AUTHORITY
INTEGRATED SYSTEM CONTROL (ISYSCON)	SIX NEW WS OPRS, TWO NEW MAINTAINERS	SIX OPR WSs IN ISYSCON SHELTER/SYSTEM	IMPLEMENT 'SWIVEL-CHAIR' WAN MGMT, IMPLEMENT NEW SIGNAL C2	'COLLATERAL' C3 EFFECTS	AUTHORITY FOR WAN TECH CTRL, SUPERVISE NEW PERSONNEL

Figure 8: ISYSCON CHALLENGES TO THE S3

individual BFA C2 users to force-wide commanders and staff. Finally, the S3 will face increased technical control authority and WAN management responsibilities, but the ISYSCON will simplify the S3's job. Figure 8 summarizes these challenges to the signal battalion S3.

SUMMARY OF RESULTS. The impacts of C3 force modernization have been analyzed for each of the C3 system of significance to this study. The cummulative impacts, by C3 functional, for the three C3 systems could prove equally challenging given that these impacts are beyond the current specific duties of the signal battalion operations personnel, in terms of MSE network operations.

Cumulative personnel impacts include eight enlisted personnel. The personnel are authorized to operate and maintain the ISYSCON workstations. By providing additional personnel, however, the net effect is to reduce the number of simultaneous tasks required and consolidate functions and personnel at a central location.

Cummulative equipment impacts will ultimately be determined by the functionality of the ISYSCON. If total ATCCS interface is achieved, then ideally, the ISYSCON would eliminate the distinct hardware provided for MCS, and the TCU/CL 2M JTIDS network equipment. Instead, signal battalion operations section personnel, and specifically the ISYSCON workstation operators could access the MCS and JTIDS appropriate software remotely from the ISYSCON hardware

through the WAN. Assuming this baseline capability is realized, the net equipment impacts are solely application software.

Cumulatively, the individually discussed procedural impacts all remain. These included ATCCS management procedures, the development and sustainment of ATCCS subsystem garrison SOPs, JTIDS network operations LMV procedural changes, ISYSCON-based automated Signal C2 procedures and force synchronization procedures. Although all these procedural changes remain, the ISYSCON facilitates execution of these procedures by allowing centralized control.

Similarly, cummulative training impacts will remain. Significantly, however, the end result is that each new training challenge provides a stepping-stone-type logical approach to the cummulative training goal. For example, the execution of MCS operator/staff user training lays a conceptual foundation the principles required to conduct coordinated signal/air defense JTIDS network operations training. That in turn provides the foundations for training 'collateral C3' and the linkages between C2 and C3 systems. Nonetheless, as with procedural impacts, the training impacts remain as C3 modernization progresses.

Finally, the leadership impacts are the most significant to the S3. In the end state, WAN management responsibilities will be significantly increased from

current MSE network operations responsibilities. Though the WAN will be managed from the ISYSCON-- a single centralized physical location, the network management perspective will expand from one of major CP-to-major CP to one of individual user-to-individual user. User access to Joint, strategic and commercial services will become a routine multiple network issue; not a case-by-case exception for any particular network. Also, battlefield spectrum management will evolve to consume communications systems frequency management and COMSEC management issues and merge these with non-communications systems management issues for radars and other spectrum using devices.

The signal battalion S3 will face significant technical and tactical challenges based on C3 force modernization. Figure 9 summarizes the cummulative impacts of C3 force modernization.

CONCLUSIONS. In this chapter, the research methodology as described in the previous chapter, is applied using the information found in reference material in an attempt to identify the impacts of C3 force modernization on the signal battalion S3 and the operations section. Current signal battalion operations, in terms of MSE equipment, SYSCON personnel and functions were described in detail to form a basis from which to assess the impacts of C3 force modernization. Individually, each of these specific C3 systems-- MCS, JTIDS, and ISYSCON were discussed. The

discussion of each system provided means of employment, operational capabilities, personnel and proposed generic training provided when the particular system is fielded. The challenges to the signal battalion operations section were assessed in terms of the C3 functional area, for each of the three systems individually. Finally, the cummulative impacts of C3 force modernization were summarized. Significant conclusions and recommendations, based on these cummulative impacts of C3 force modernization challenges will complete this study. The conclusions and recommendations are started in the following final chapter of this thesis.

C3 FUNCTIONAL AREAS

FORCE INTEGRATION PROGRAMS	PERSONNEL IMPACTS	EQUIPMENT IMPACTS	PROCEDURES IMPACTS	TRAINING IMPACTS	LEADERSHIP IMPACTS
CUMMULATIVE CHALLENGES	EIGHT NEW ENLISTED PERSONNEL	ATCCS/WAN ACCESS AND APPLICATION SOFTWARE	ATCCS MGMT, GARRISON SOPs, JTIDS LMV, AUTOMATED SIGNAL C2	MCS OPR/ STAFF USER, SIG/ADA JTIDS NET OPERATIONS, 'COLLATERAL' C3 EFFECTS	JOINT AND WAN MGMT, ATCCS TECH CTRL AUTHORITY, SIG MFA FLC MGMT, SUPERVISOR FOR NEW PERSONNEL

Figure 9: SUMMARY OF RESULTS: CUMMULATIVE CHALLENGES TO THE S3

CHAPTER 4

ENDNOTES

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(8)<u>FM 11-38</u> (1991), 1-4.

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(70)Ibid., D-2.

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CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

INTRODUCTION. In this chapter, final conclusions are stated following a brief review of the previous chapters. The research question is answered directly. Recommendations are made in terms of actions which should be taken by Army combat developers, materiel developers, and signal officers. Lastly stated are suggested items for further study.

The first chapter of this thesis serves as a foundation for research. An explanation is provided on how the role of the signal officer has grown to parallel the advances in information technology during the past decade. The explanation examines the relationship between the key signal battalion leaders and major C3 force modernization programs in the 1990s-- the decade of command and control, to ask how the divisional MSE signal battalion S3 operations are affected by C3 force modernization. The significant issue being that C3 force modernization will occur swiftly and continuously in the near future, allowing little time for effectively applying lessons learned from each C3 system fielding to curb the challenges of operating the aggregate

Army Tactical Command and Control System (ATCCS). The thesis is provided as a frame of reference for anticipating the challenges of C3 force modernization.

The second chapter provides the reader an annotated bibliography of reference material to provide an early survey into the current state of published knowledge of the challenges of C3 force modernization. Though research revealed sparse reference information on the impacts of C3 force modernization, significantly valuable information, in the early development stages, was reported on the ATCCS, and the management on the battlefield for this immense distributed automation network. Coupled with current doctrine on how the signal battalion operations section does business with MSE, the reference material provided the information needed for analysis.

Chapter three describes the research analytic methodology. Discussion reveals how three specific C3 force modernization programs will be assessed to determine the cummulative impacts of C3 force modernization on the current operations of the signal battalion S3. The three specific systems are the Maneuver Control System (MCS), the Joint Tactical Information Distribution System (JTIDS), and the Integrated System Control (ISYSCON). The first, MCS, represents the S3 becoming an ATCCS automation user. The second, JTIDS, involves a new communications system to support an ATCCS automation system. The ISYSCON addresses

the impact of a network used to manage multiple ATCCS communications and automation networks. The criteria for assessing the impacts are described as C3 functional areas: personnel, equipment, procedures, training, and leadership.

The application of the analytic methodology is presented in chapter four. The procedures used first discusses current signal battalion operation with respect to MSE network operations. Next a discussion and analysis of each system is provided. The discussion covers operational means of employment, operational capabilities of the system, and proposed personnel and training concepts. The analysis assesses the impacts of each system by C3 functional area. A summary of results assesses the cummulative impacts by C3 functional area of all three C3 force modernization systems.

CONCLUSIONS. The answer to the research question is a clearly resounding yes! Yes, C3 force integration will impact the divisional signal officer's ability to execute the mission. The focus of the research was to answer how C3 force modernization will impact the division MSE Signal battalion S3 operation, by C3 functional area. This requires more than a single word response.

Figure 9, at the end of the previous chapter, summarized the cummulative impacts of C3 force modernization for MCS, JTIDS, and ISYSCON. To consider each of the cummulative C3 functional area impacts in the aggregate,

specific conclusions can be made. Also, considering that with the information technology explosion of recent years, the private sector has tended to exist at the forefront, with the Army driving requirements, but lagging in actual implementation and use of such products, such specific conclusions may be validated.

In the end state, there is an extremely powerful WAN composed of multiple automated C2 systems interconnected by multiple, but integrated supporting C3 networks. Technology will allow each individual C3 subscriber on the battlefield access to information resident at strategic, operational, and tactical levels. The control and access of such information, and the means by which access is provided, will be a network management challenge-- the responsibility of the signal battalion S3. The S3's direct span of personnel support will increase almost two-fold; from ten Signal soldiers to eighteen total authorized. The addition personnel and the centralization provided by the ISYSCON facilitate meeting such network management challenges-- assuming the system's anticipated capabilities are in fact available.

The staff users and managers of the WAN are the S3 and the senior personnel in the Signal operations section. These include five key personnel: the S3; the captain, assistant S3; the lieutenant, systems integration officer;

the tactical automation networks technician warrant officer; and the senior operations sergeant.

The deficiency revealed by this analysis is that these staff users and managers may not be provided adequate technical and subject matter training and experience to meet the procedural and network management challenges imposed by C3 force modernization and the needs of the supported maneuver elements. Despite this deficiency, these same leaders will be responsible to conduct unit sustainment training.

For the three systems analyzed, it was concluded that the MCS and JTIDS unique hardware could be replaced by the fielding of the ISYSCON. From the ISYSCON workstations, the Signal battalion operations personnel could access either of the former network systems through the WAN, electronically. Thus, though the ISYSCON makes the S3's job easier, the challenges focus on the use of the ISYSCON.

It will be routine to train the ISYSCON operators how to 'walk through' any individual software package on ISYSCON. This type of training is routine today. The challenge will be to train soldiers on what was termed 'collateral C3'-- the effects of one operators actions on the entire C3 framework; the linkages between the interconnected C2 and C3 systems. Then, once each operator and manager know the collateral C3 effects of any one of the

five ISYSCON workstations/software package, the challenge of cross training must be confronted.

The bottom line is that each manager in the signal operations section, and each ISYSCON operator must then be trained to understand each of the five ISYSCON functions (battlefield spectrum management, network planning and engineering, WAN management, signal C2, and ISYSCON system administration) and their 'collateral C3' effects on how the division conducts tactical operations. This represents an drastic change from current Signal training philosophy, in which each soldier is a trained expert in only one any such function.

RECOMMENDATIONS. To assist the S3 and his staff section, the institutional base must deliver high quality, high-capability, comprehensive, network-based systems and training for those systems. This must be done initially! The opportunities of the past to 'fix the training later' and 'learn how to use it in the field' will be intolerable in the future. Specific recommendation are made below for combat developers, materiel developers, and Signal officers.

Combat developers must refine and integrate ATCCS management, including WAN management, principles into materiel requirement and doctrine. Technical and subject matter expertise must transition into training development early enough in the process to ensure collateral C3

implications are institutionalized when the C3 systems are fielded.

Materiel developers must understand the intent of materiel requirement in the broader context of the collateral C3 framework, and develop systems which meet requirements. To do so allows the development of embedded training software to meet the comprehensive collateral C3 training challenge.

Signal officers must proactively pursue technical and subject matter self development training opportunities in ATCCS management and WAN management-- including commercial applications and anticipate the fielding of ATCCS systems. In implementation of the tactical IMA with regards to the ATCCS, the Signal officer and the supported unit commanders and staff must agree to clear and definitive understanding of the interfaces required to support the tactical scheme of maneuver. To do so will allow future Signal officers to meet the challenges in the decade of command and control.

Force integration changes to doctrine, materiel, organizations, and their supporting architectures are occurring simultaneously. Each program independently provides significantly new challenges to the Signal officer. Each supplies competing needs for the Signal officer's expertise.

There is a need for an in-depth look into the cummulative impacts of C3 force integration on the operations of the divisional Signal battalion-- down to the who-does-what level. This thesis has identified a few of the challenges to the Signal officer based on MCS, JTIDS, and ISYSCON force modernization, but many issues still exist. A few are mentioned below as topics for subsequent study.

ITEMS FOR FURTHER STUDY. Items that require further study include assessing the impacts of other ATCCS systems on the signal battalion operations section, analyzing the impacts of C3 force modernization with respect to the emerging Airland Operations doctrine, and investigating the effects of organizational force modernization, e.g., Joint Specialty Officers and Army Acquisition Corps, on the divisional signal battalion. Efforts similar to this effort may be conducted to assess the impacts of C3 force modernization on low intensity conflict, joint and coalition warfighting.

Finally, study is required investigating further the impacts of Army downsizing and force modernization, because significantly, even as these final words are authored, plans for Army downsizing and C3 force modernization are rapidly changing again. These plans will most assuredly continue to provide 'Challenges to the Signal Officer in the Decade of Command and Control'!

APPENDIX

DEFINITION OF TERMS

Army Tactical Command and Control System. The Army Tactical Command and Control System (ATCCS) is both a system of systems, and a concept at Army echelons corps and below (ECB) that represents the aggregate means by which Army commanders employ and sustain military forces in a theater of operations. It is one of the means through which the commander and his staff perform C2 functions. The ATCCS is designed to facilitate information flow on the battlefield and enhancing the force commander's tactical decision making process. The ATCCS is comprised of five battlefield functional areas (BFA): maneuver, air defense, fire support, intelligence/electronic warfare, and combat service support (CSS). Each BFA supports C2 with the aid of an automated C2 system. They are the Maneuver Control System (MCS), the Forward Area Air Defense System (FAADS), the Advanced Field Artillery Tactical Data System (AFATDS), the All Source Analysis System (ASAS), and the CSS Control System (CSSCS).(1)

Command and Control. Command and Control (C2) is "the exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of a mission. C2 functions are performed through an arrangement of personnel, equipment communications, facilities and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations."(2)

Command, Control and Communications. Command, Control and Communications (C3) is a term that is basically undefined in most formal military texts. Although the term C3 is generally accepted, the definition is twisted by semantics and perception. For the purposes of this thesis, C3 will be defined as communication networks to support C2, or the combination of C2 automation support systems and communications networks.

Force Integration. Force integration is the process used to manage orderly change in the Army. "It is the

introduction, incorporation and sustainment of new doctrine, organizations and equipment into the existing force structure."(3)

Integrated System Control. The Integrated System Control (ISYSCON) is an automated system designed to manage multiple communications and automation systems in real time. ISYSCON provides the necessary tools to perform the management process by automating essential functions, including: network planning and engineering, battlefield spectrum management, wide area management, communications security management, and command and control of Signal units. The ISYSCON will incorporate six standard workstations into a LAN to perform communications networks command and control, distributed database management, and network engineering task processing. The ISYSCON will electronically interface to other ISYSCONs, subordinate communications control facilities, and BAS' as required to perform systems planning, control, monitoring,and gateway management between alternate, adjacent, and to strategic networks.(4)

Joint Tactical Information Distribution System. The Joint Tactical Information Distribution System (JTIDS) is a secure, jam-resistant data communications system. The JTIDS Class 2M radio set for computer communications is one of the elements of the Army Data Distribution System (ADDS). The JTIDS component of the ADDS is used to support the Air Defense Artillery (ADA) battlefield automated systems (BAS) JTIDS supports communications requirements which require joint service interoperability, high digital data rates, or high anti-jam capabilities.(5)

Maneuver Control System. The Maneuver Control System (MCS) is a corps-wide decision support system designed to meet the maneuver C2 needs of the tactical commander and his staff. MCS provides automated assistance to commanders and staffs to facilitate the management of battlefield information and the execution of the commander's concept of the operation. The hardware suite consist of the MILSPEC Tactical Computer Terminal (TCT), and the nondevelopmental items (NDI) Tactical Computer Processor (TCP) and Analyst Console (AC). The software suite includes a distributed database that provides accurate and timely text and graphics information and operational tools to support the commander's decision making process. All hardware devices communicate over standard tactical communications networks and between NDI devices over a local area network (LAN). MCS will be fielded at

corps, division, brigade and battalion levels.(6)

APPENDIX
ENDNOTES

(1)U.S. Army Command and General Staff College, C4000-11, Contingency Force Operations, Command, Control, Communications, and Synchronization (U.S. Army Command and General Staff College, 1990), L11-I-1.

(2)U.S.Army Combined Arms Combat Developments Activity, Army Command and Control Master Plan, Volume I, Desktop Reference 1990 (U.S.Army Combined Arms Combat Developments Activity, 1990), E-6.

(3)U.S. Army Command and General Staff College, Chapter 4, ST 25-1, How the Army Runs (U.S. Army Command and General Staff College, 1990), 4-1.

(4)U.S. Army Signal Center, Memo, Subject: Required Operational Capabilities (ROC) for the Integrated System Control (ISYSCON) (FT. Gordon, GA.: U.S. Army Signal Center, 1990), 1.

(5)U.S. Army Signal Center, Memo, Subject: Doctrinal and Organizational Test Support Test Package--Joint Tactical Information Distribution System (JTIDS) (FT. Gordon, GA: U.S> Army Signal Center, 1990), 1.

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